



# Volunteer Summer Study



Guadalupe River at Rio Robles  
Photo courtesy of Larry Hesketh

# 2023



# 2023 Volunteer Summer Study

## INTRODUCTION

The Guadalupe River is one of the highest rated recreational and scenic rivers in Texas and is Kerr County's central asset. The river provides water to the citizens for domestic, agricultural, municipal, and recreational purposes. Therefore, maintaining excellent water quality is essential. Water quality is determined by the amount of contaminants in the water; as contaminant levels increase, water quality decreases. There are many types of potential contaminants originating from many sources. The objective of this study was to determine the level of one contaminant, *E. coli*.

*E. coli* bacteria levels are commonly monitored to assess the quality of surface water because they are an indicator of water contamination. *E. coli* originates in the intestines of warm-blooded animals and the presence of *E. coli* indicates that warm-blooded animal feces have reached the water and that pathogens may be present. Sources of *E. coli* can include inadequately treated sewage, livestock, pets, birds, and mammals.

Each summer, the Upper Guadalupe River Authority (UGRA) tests for *E. coli* levels at popular swimming holes throughout Kerr County. The results of this Swimability Study are compared to the Texas Commission on Environmental Quality's (TCEQ) standards for contact recreation. For a single grab sample, the standard for contact recreation set by TCEQ is 399 colonies of *E. coli* bacteria per 100 milliliters (mL). If *E. coli* levels are greater than 399 colonies of bacteria per 100 mL, then there is a higher risk of contracting waterborne illness while swimming.

In 2004, UGRA began the Volunteer Summer Study Program to supplement data collected during the Swimability Study and to include interested members of the community in water quality testing. The information collected by the volunteers also helps identify areas in need of further investigation.

This summer we were assisted by 27 volunteers who collected 330 samples at 40 locations throughout Kerr County. UGRA commends the efforts of these volunteers for taking an active role in protecting the water quality of our river. Working together, we can maintain the pristine nature of the Guadalupe River and protect our community's most valuable natural resource.

## 2023 VOLUNTEERS AND SAMPLE SITE LOCATIONS

| Location   | Volunteer                         |
|--|-----------------------------------|
| North Fork Guadalupe River at Guadalupe Ranch Estates Shallow Water Park | Robert Bowles                     |
| North Fork Guadalupe River at MO-Ranch                                   | MO-Ranch Staff                    |
| North Fork Guadalupe River at Benson Crossing                            | Bob & Karen Taylor                |
| North Fork Guadalupe River at Wagon Wheel Crossing                       | Clinton Morse                     |
| North Fork Guadalupe River at Graham Crossing                            | Bob & Karen Taylor                |
| North Fork Guadalupe River at Friedrich Crossing                         | Bob & Karen Taylor                |
| North Fork Guadalupe River at Hope Crossing                              | Nancy Huffman                     |
| North Fork Guadalupe River at Lonestar Crossing                          | Bake Foster                       |
| North Fork Guadalupe River at Mayhugh Crossing                           | Bake Foster                       |
| South Fork Guadalupe River downstream of Angel Falls                     | Dee Elliott                       |
| Guadalupe River at Ingram Lake Boat Ramp                                 | Nellwyn Sadler                    |
| Guadalupe River at Ingram Park*  | Patrick Andrews                   |
| Guadalupe River at Lower Cade Loop                                       | Alice King                        |
| Guadalupe River at Indian Creek Crossing                                 | Nellwyn Sadler                    |
| Goat Creek at Headwaters   | Maura Windlinger                  |
| Goat Creek near I-10   | Maura Windlinger & Palmore Baxter |
| Goat Creek at KOA  | Palmore Baxter                    |
| Lime Creek at Lime Creek Apartments*                                     | Patrick Andrews                   |
| Guadalupe River at Nimitz Lake Cypress Park                              | Carl & Katy Kappel                |
| Guadalupe River at Nimitz Lake Knapp Park                                | Carl & Katy Kappel                |
| Guadalupe River at Guadalupe Park  | Alice King                        |
| Town Creek at Town Creek Road  | Phil Youngblood                   |
| Town Creek at Morris Road**  | Trudy Eberhardt                   |
| Town Creek at Guadalupe Cemetery**                                       | Jim Gardner                       |
| Town Creek at Schreiner Street**   | Jim Gardner                       |
| Guadalupe River at Town Creek Confluence                                 | Trudy Eberhardt                   |
| Guadalupe River at Louise Hays Park Footbridge                           | Sherry Wilson                     |
| Guadalupe River at Rio Robles*   | Larry Hesketh                     |
| Guadalupe River at G Street  | Deb Youngblood                    |
| Quinlan Creek at Habitat Park*   | Larry Hesketh                     |
| Quinlan Creek at Hwy 27*   | Lizbeth Lopez                     |
| Guadalupe River at Flat Rock Lake Boat Ramp*                             | Jim Gardner                       |
| Guadalupe River at Flat Rock Lake Dog Park                               | Sherry Wilson                     |
| Guadalupe River Below Flat Rock Lake Dam**                               | Clark Williams                    |
| Guadalupe River at Wharton Road  | John Hornung                      |
| Turtle Creek at Rocky Hill Drive   | Kathy Loring                      |
| Turtle Creek at Fall Creek Road  | Kathy Loring                      |
| Guadalupe River at Government Crossing                                   | Patricia Higgins                  |
| Guadalupe River at Verde Creek Confluence                                | Patricia Higgins                  |
| Guadalupe River Upstream of Lane Valley                                  | Paz Lovett                        |

\*Indicates fewer than 5 samples were taken.

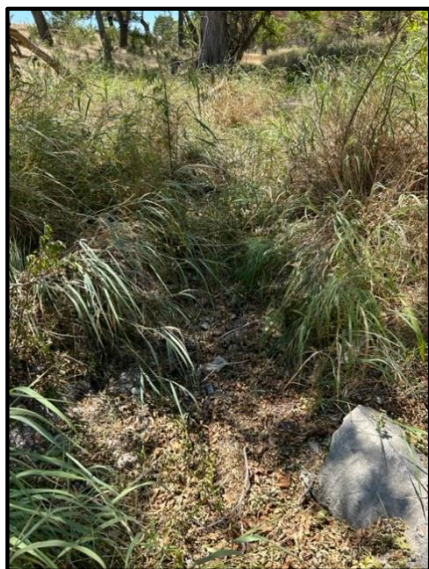
\*\* Indicates fewer than 5 samples were taken due to site drying up.



## RESULTS

The following pages contain the results of the Volunteer Summer Study for 2023. While all sample sites are included in the individual reports starting on page 10, not all are included in the geometric mean chart (see page 31) due to low sample size. Additionally, two sites selected by volunteers could not be sampled (Bear Creek at Bear Creek Road and Camp Meeting Creek at Ranchero Road) because the sites were dry due to intense drought conditions (see images below). The results are displayed in chart format indicating the level of *E. coli* found at each site on the dates they were sampled. A picture of the sample site, if available, is placed next to the results along with the name of the volunteer monitor. A solid red line is displayed on some charts at 399 *E. coli* colonies per 100 mL to indicate the *E. coli* single sample standard set by the Texas Commission on Environmental Quality (TCEQ) for contact recreation. *E. coli* values above the red line represent conditions with increased risk of contracting waterborne illness. A dotted red line on a chart indicates the upper limit of the test. This means the specific sample result was not determined, but it is greater than the value indicated by the dotted red line. The last chart represents the geometric mean *E. coli* values for all sites sampled at least five times during the 2023 Volunteer Summer Study. While a five-sample minimum is needed to accurately calculate the geometric mean, various circumstances led to some sites being sampled on fewer than five occasions. Geometric means for the UGRA Summer Swimability Study are included in the report for additional context (see page 30). Geometric means are used to summarize *E. coli* values instead of an average because bacteria values have a wide range and can fluctuate greatly from week to week. TCEQ considers a geometric mean value greater than 126 *E. coli* colonies per 100 mL to exceed standards for primary contact recreation.

During the summer 2023 volunteer monitoring period, streamflow rates in the Guadalupe River were well below average as recorded by the U.S. Geological Survey streamflow gage in Kerrville (see page 6). Below average rainfall in 2022 was compounded in 2023 and the drought conditions continued to intensify. A brief respite was seen in May 2023 which brought above average rainfall (6.08 inches), as recorded by the Knippling-Bushland U.S. Livestock Insects Research Laboratory in Kerrville, however, all other months in 2023 received below average rainfall (see page 7). According to the U.S. Drought Monitor, Kerr County was in drought throughout the entire volunteer monitoring period (see pages 7-9). Sites along Town Creek and even the main stem of the Guadalupe River went dry during the volunteer monitoring period. However, the sites were included in this report to reflect the severity of the drought and its impact on water quality.



Bear Creek at Bear Creek Road (left) and Camp Meeting Creek at Ranchero (right) could not be sampled in 2023 due to drought.

During the 2023 Volunteer Summer Study, 11 out of 40 sites contained individual samples with *E. coli* counts greater than 399 colonies per 100 mL. While some of these individual samples followed the few rainfall events this area received, it is likely that the majority of high *E. coli* values were a result of wildlife presence, minimal flow, and warm water temperature. A geometric mean value was compiled for each site with five or more samples to evaluate the overall bacteria level for the summer.

The only volunteer site with a calculated geometric mean greater than 126 colonies per 100 mL was the Guadalupe River at the Town Creek confluence just downstream of the River Trail footbridge over Town Creek (geometric mean 463 colonies per 100 mL). UGRA Natural Resources Specialist, Matthew Wilkinson, took a sample on October 11<sup>th</sup> as a follow up to the data collected throughout the sampling period. That follow up sample had an *E. coli* value of 96 colonies per 100 mL which was significantly lower than the last sample taken during the sampling period and brought the geometric mean down to 380 colonies per 100 mL (see page 22). While this geometric mean is still above the standard, it indicates a possible drop in *E. coli* levels at that location. In the past, Town Creek has been the subject of investigations and routine sampling. UGRA will continue routine sampling efforts in the future. Information about nonpoint source pollution from urban runoff in Kerr County is discussed in the “Bacteria Reduction Plan for the Upper Guadalupe River” accessible through the UGRA webpage at [www.ugra.org/major-initiatives/bacteria-reduction-plan](http://www.ugra.org/major-initiatives/bacteria-reduction-plan).

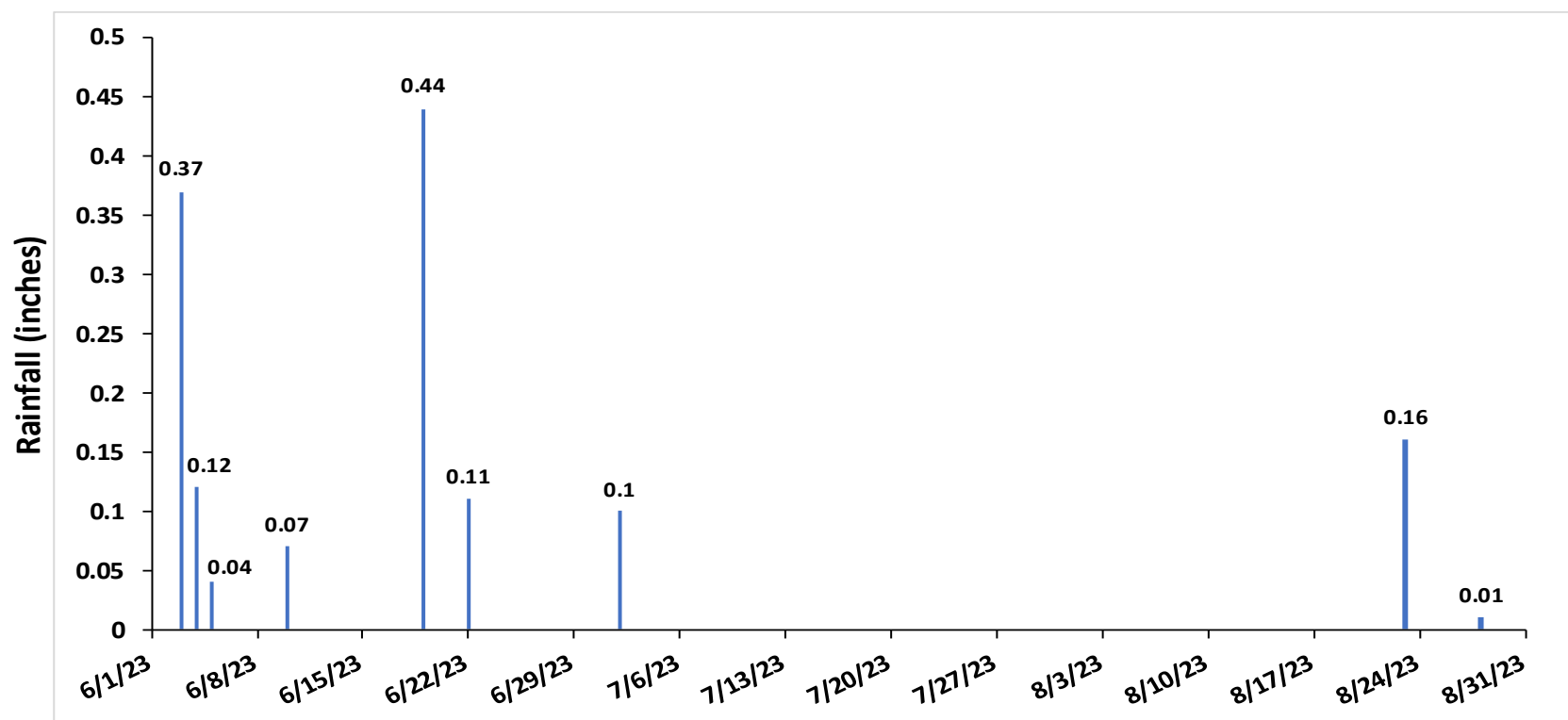
Town Creek had four sites where samples were taken this year. All of them went dry during the monitoring period and only one (Town Creek at Town Creek Rd.) had a sufficient sample size to calculate a geometric mean which was below 126 colonies per 100 mL. Of the remaining three sites (Town Creek at Morris Rd., Town Creek at Guadalupe Cemetery, Town Creek at Schreiner St.), two had individual samples above 399 colonies per 100 mL (Town Creek at Morris Rd., Town Creek at Guadalupe Cemetery). A noteworthy observation is that individual samples in two of these locations taken on July 6<sup>th</sup> show *E. coli* values below 399 colonies per 100 mL. It is hypothesized that the remaining small pools in these locations, before completely drying up, were exposed to extreme heat and ultraviolet radiation during late June and early July, possibly causing much of the *E. coli* to die off.

During the 2022 volunteer sampling period, all three sample sites on Quinlan Creek had geometric means above 126 colonies per 100 mL. In 2023, the two sites on Quinlan Creek that were sampled had insufficient sample sizes to calculate a geometric mean, however, there were no individual samples above 399 colonies per 100 mL.

Summer 2023 saw consistently dry, hot weather. Many of the small pools and shallow water with minimal flow were expected to show high *E. coli* values. However, most locations sampled during the Volunteer Summer Study and the UGRA Summer Swimability Study had surprisingly low *E. coli* values. As previously mentioned, it is possible that this is due to the intense heat and ultraviolet exposure.

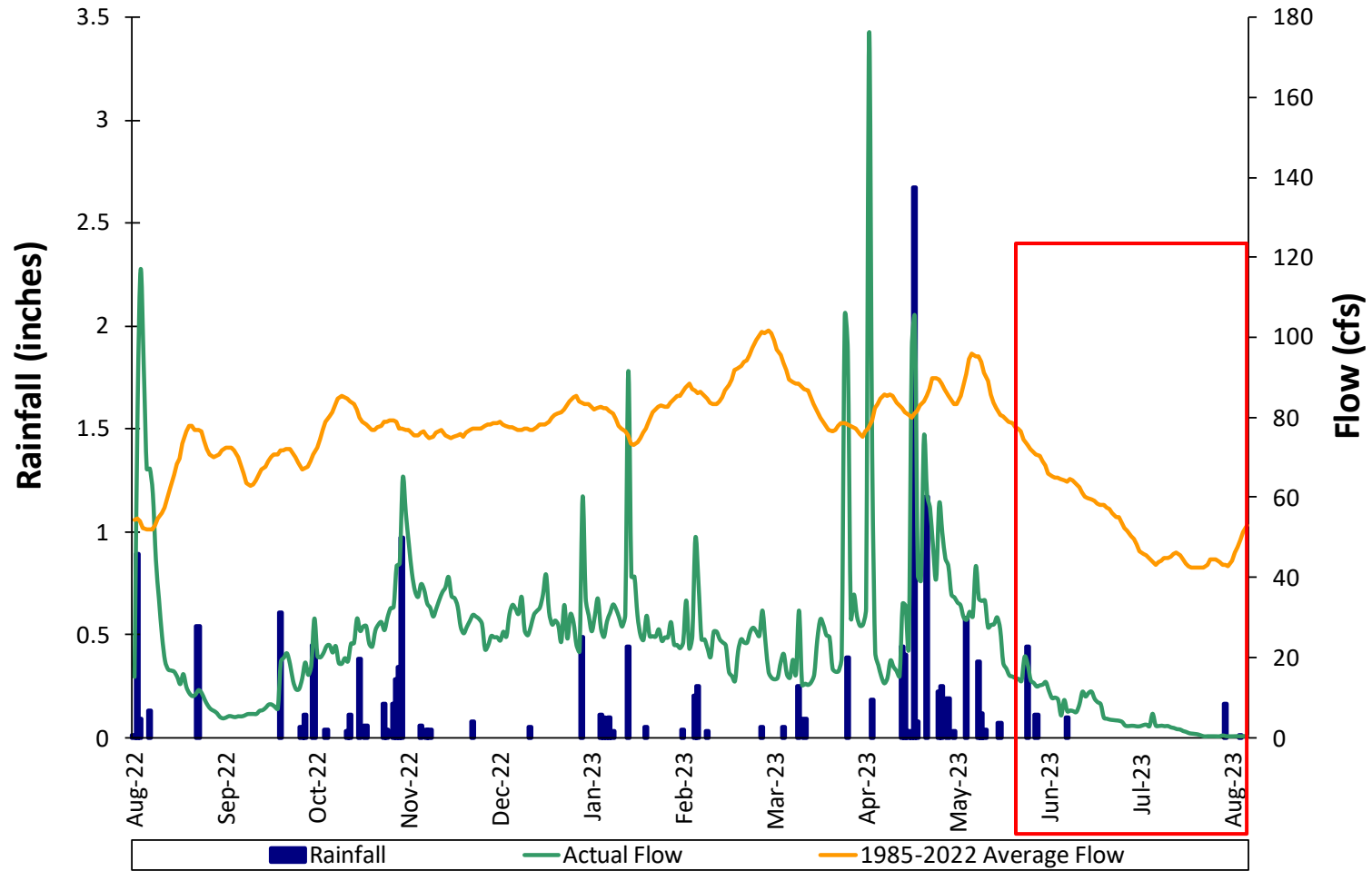
## 2023 RAINFALL, FLOW, AND DROUGHT CONDITIONS

RAINFALL TOTALS 06/01/2023 – 08/31/2023



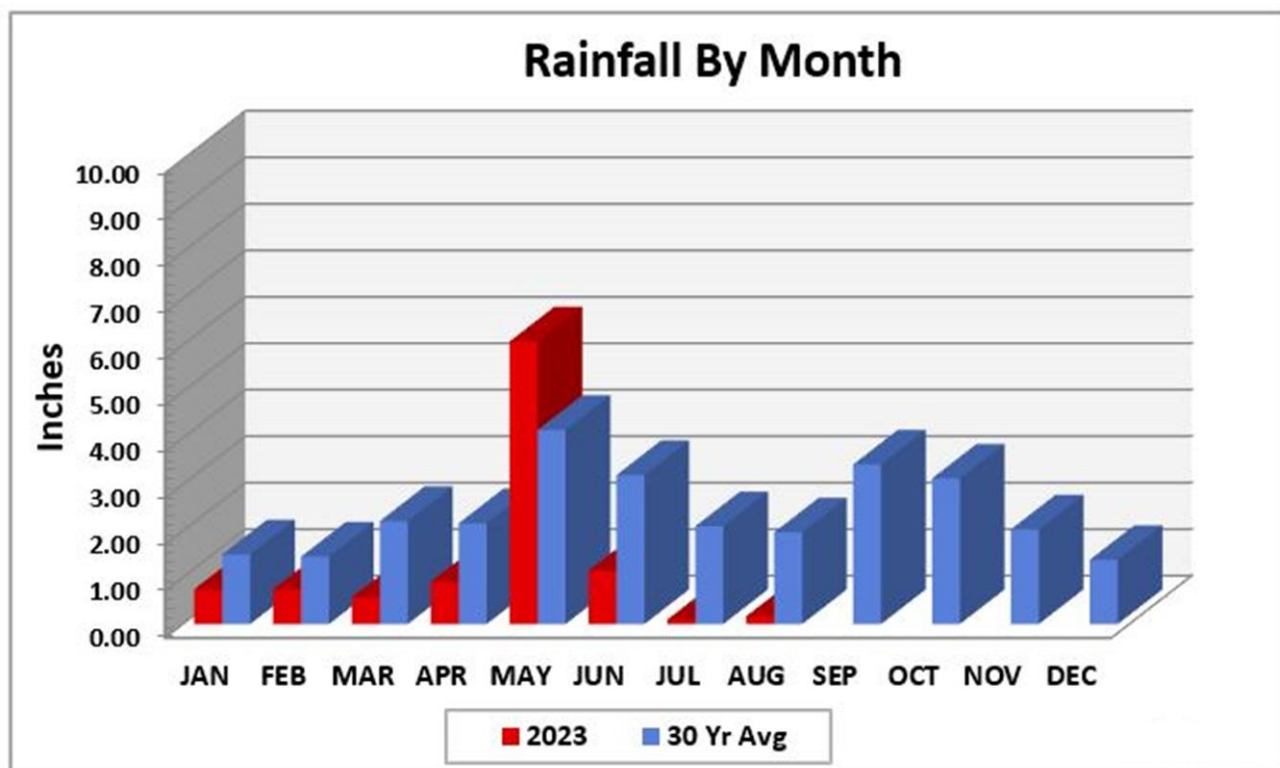
From June 1<sup>st</sup> – August 31<sup>st</sup> only 1.42 inches of rainfall was recorded by the Knipling-Bushland U.S. Livestock Insects Research Laboratory in Kerrville. This is a 67% decrease from the same period in 2022 (4.3 inches) which followed a 55% decrease from 2021 to 2022. The 30-year average for this timeframe is 7.3 inches.

### RAINFALL vs FLOW



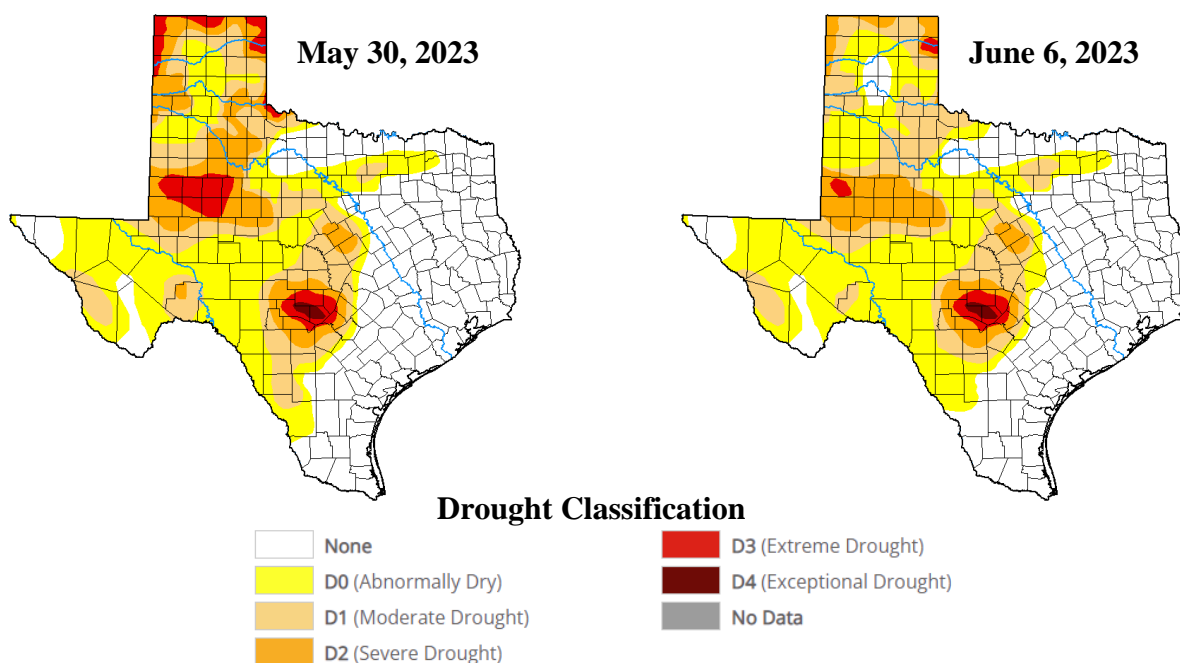
Nearly nonexistent rainfall caused already low streamflow to decrease to virtually 0 cubic feet per second during the volunteer monitoring period (outlined in red).

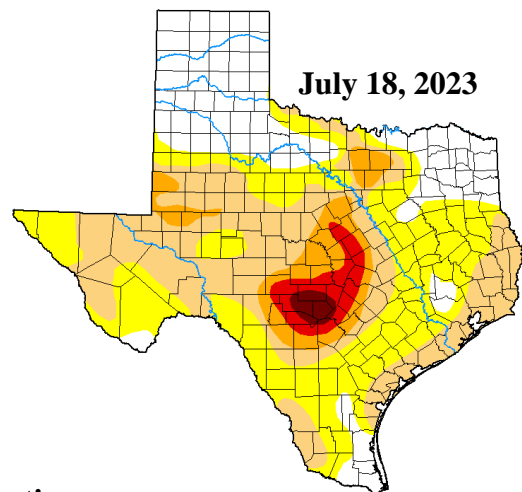
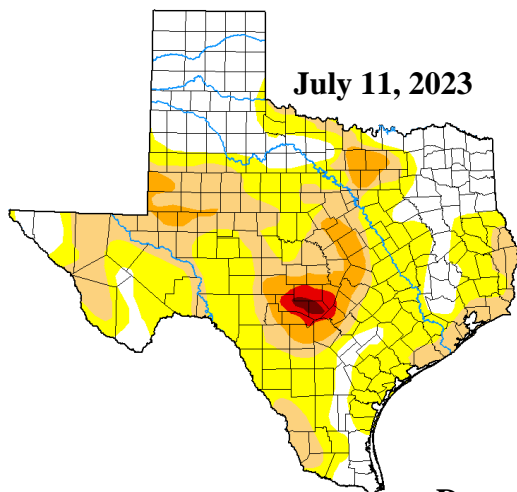
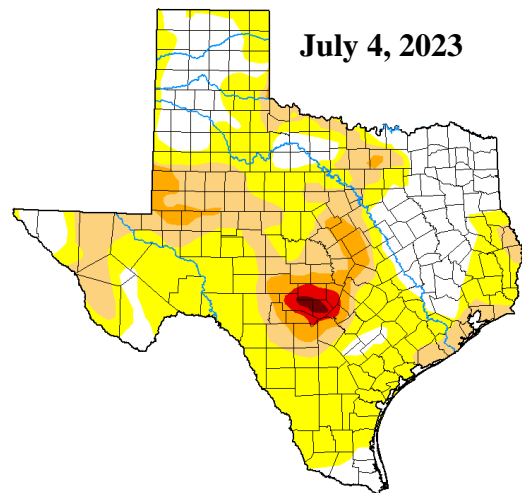
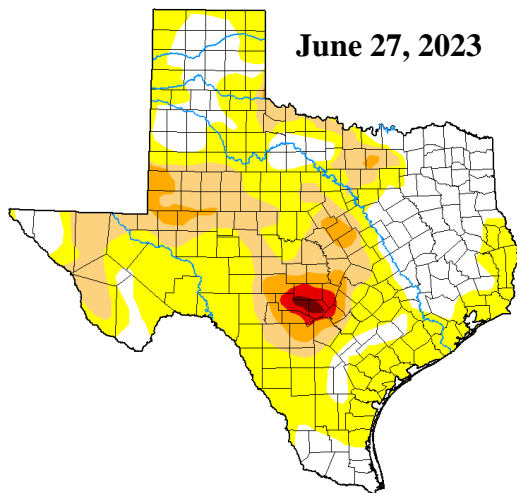
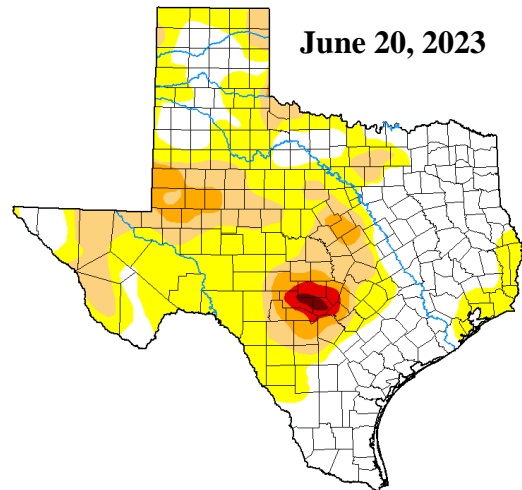
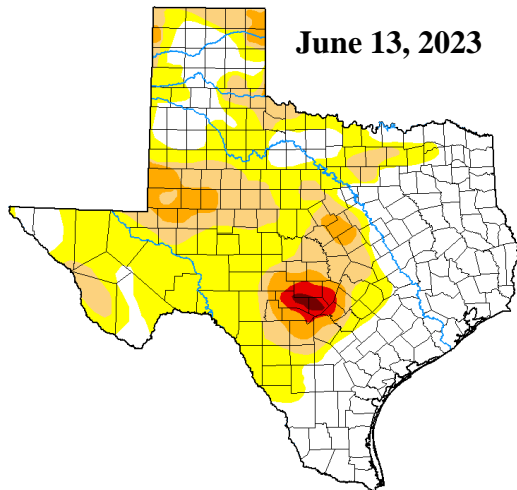




The long term trend of below average rainfall began in November 2021 and has continued through 2023 with the exceptions of August and November 2022 and May 2023. Since the 2022 volunteer monitoring period, drought conditions have intensified in Kerr County. Throughout the 2023 volunteer monitoring period, Kerr County remained in D2 (Severe Drought), D3 (Extreme Drought), or D4 (Exceptional Drought) drought classification.

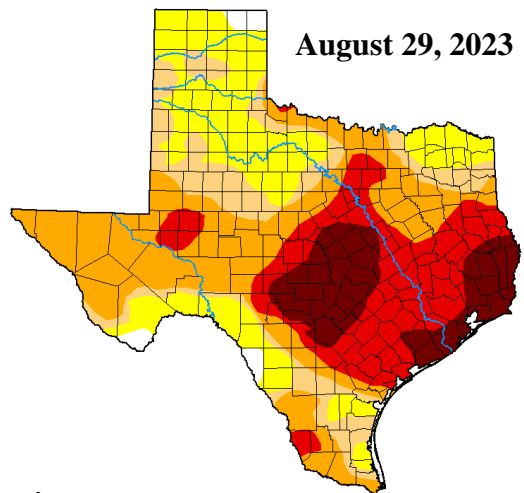
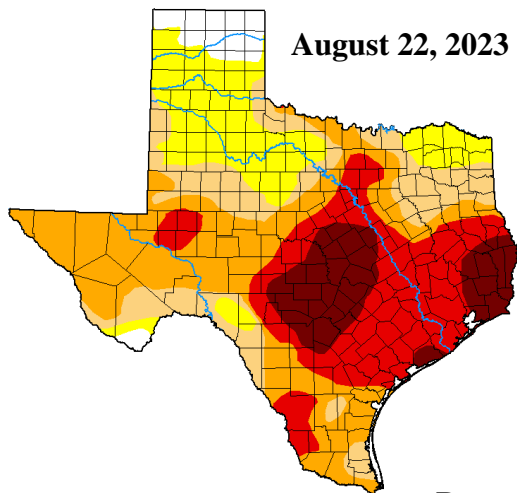
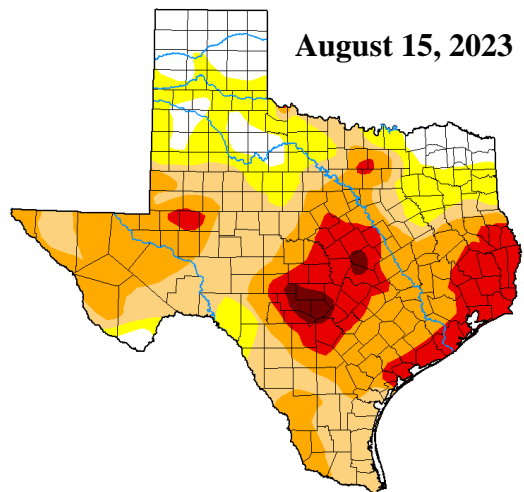
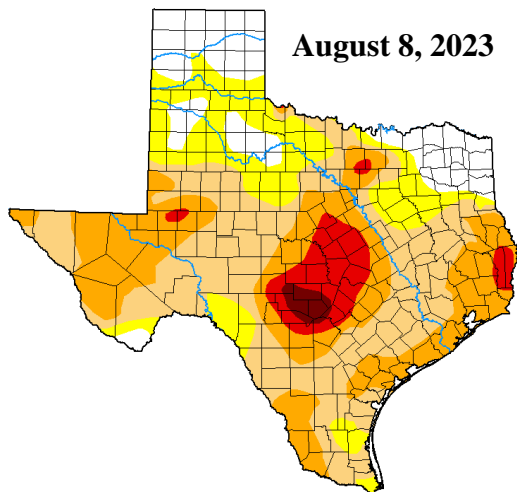
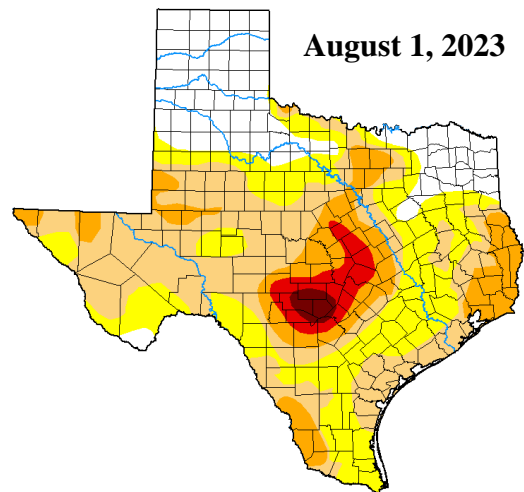
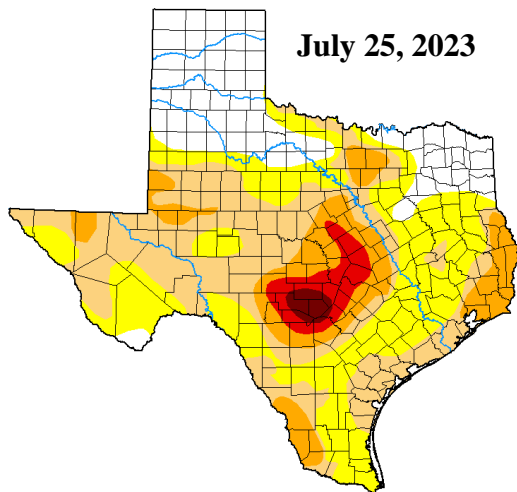
## WEEKLY DROUGHT MAP COMPARISON





### Drought Classification





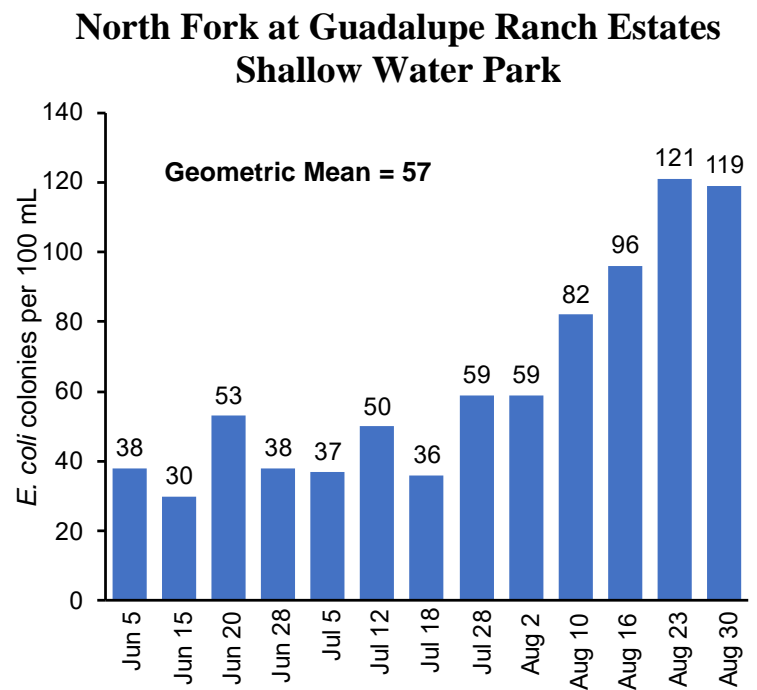
### Drought Classification



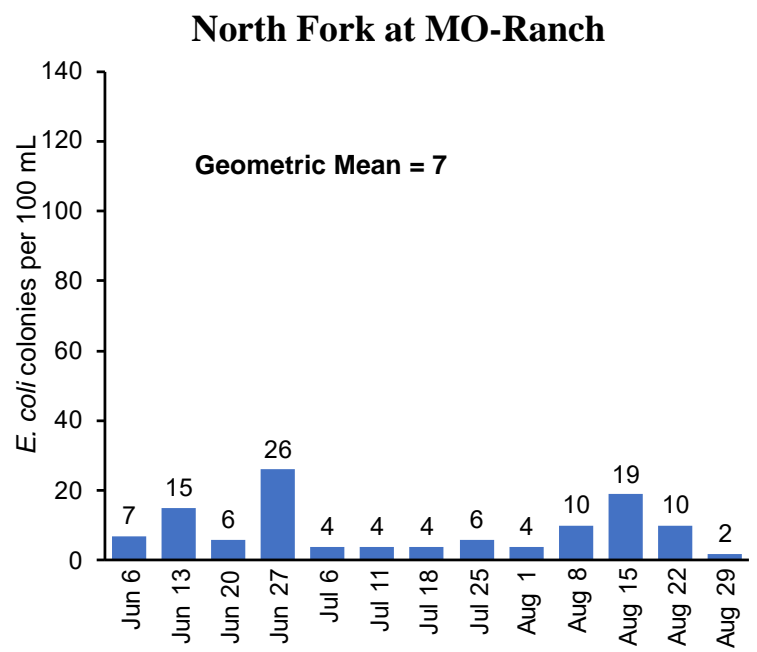
## RESULTS BY SAMPLE SITE



Robert Bowles



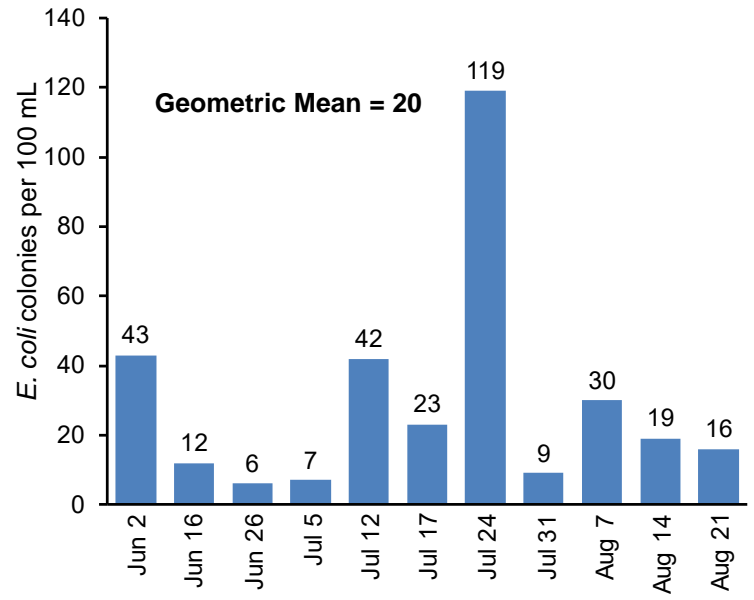
MO-Ranch Staff





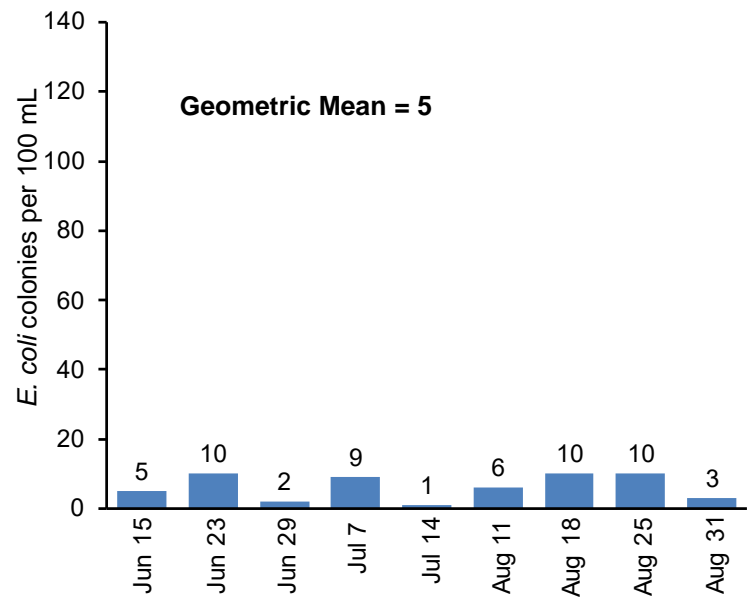
Bob and Karen Taylor

### North Fork at Benson Crossing



Clinton Morse

### North Fork at Wagon Wheel Crossing

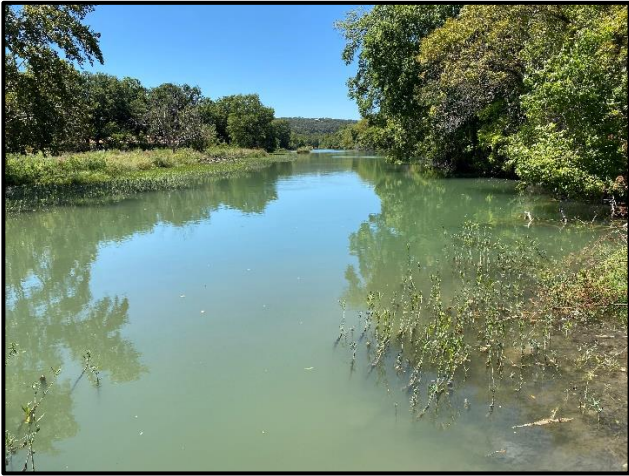
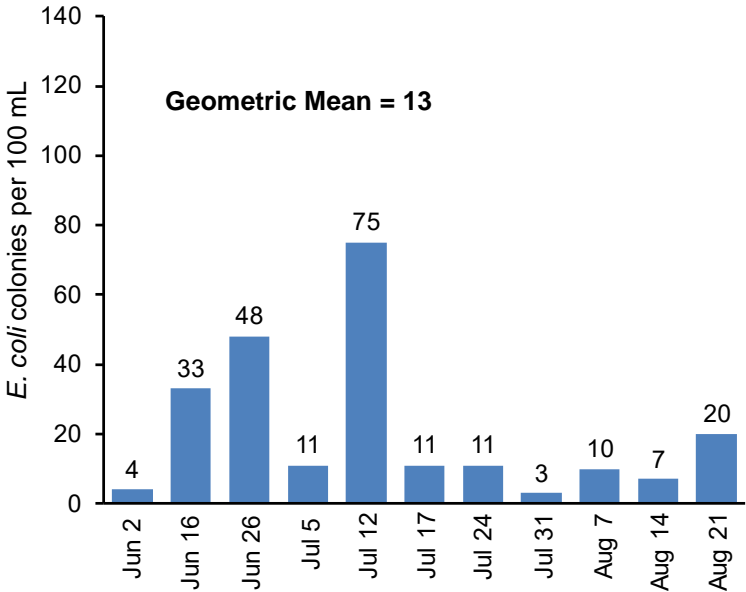






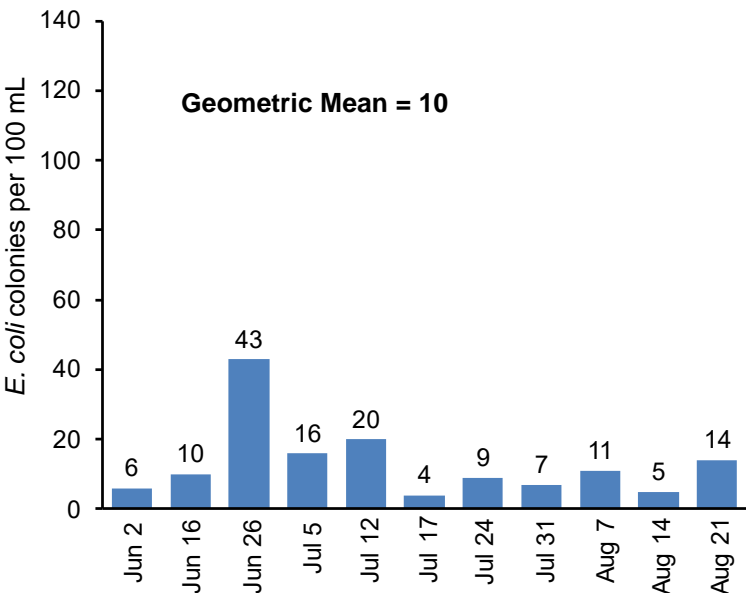
Bob and Karen Taylor

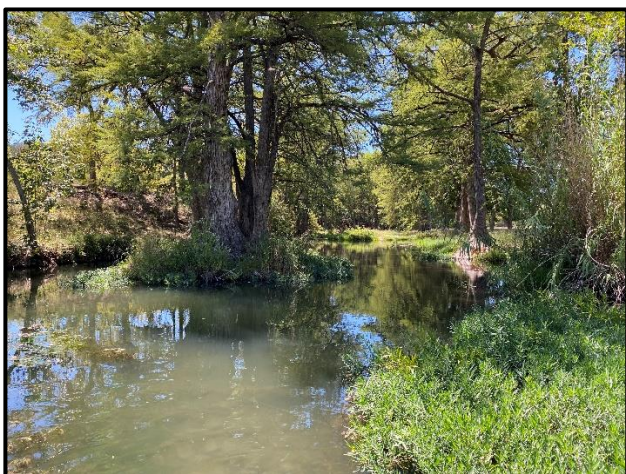
### North Fork at Graham Crossing



Bob & Karen Taylor

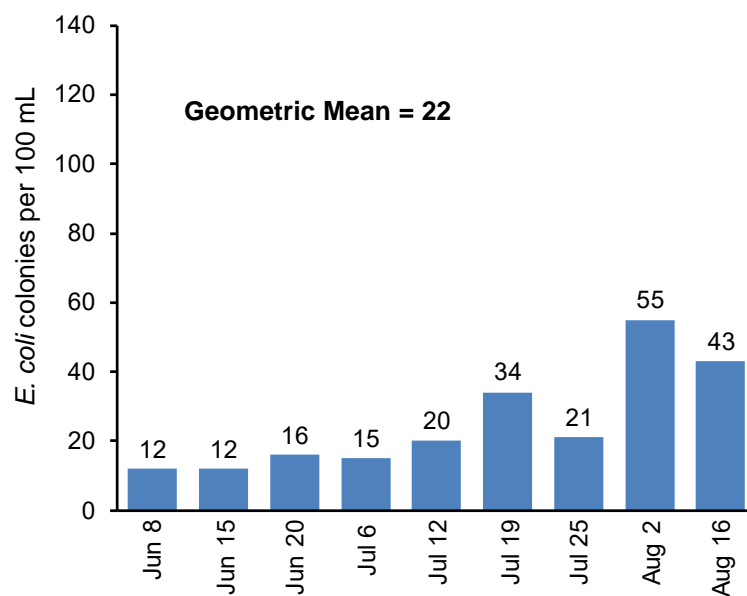
### North Fork at Friedrich Crossing





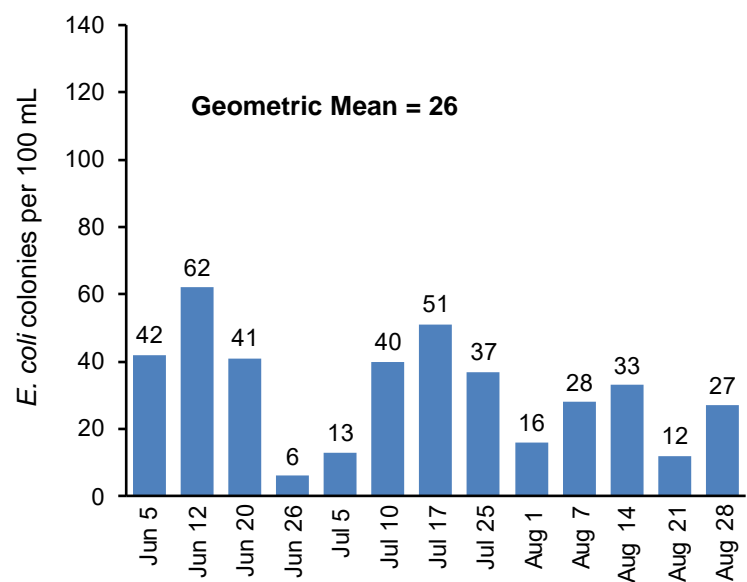
Nancy Huffman

### North Fork at Hope Crossing



Bake Foster

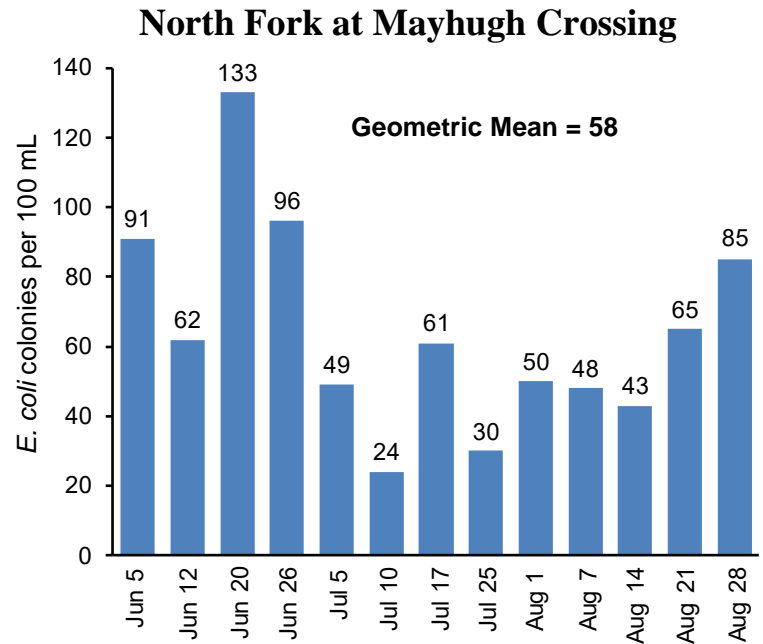
### North Fork at Lonestar Crossing



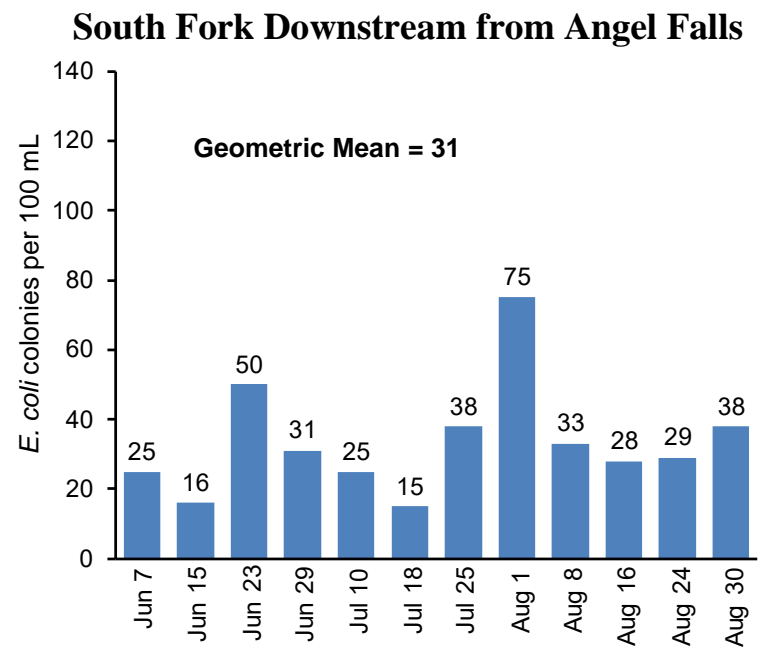




Bake Foster



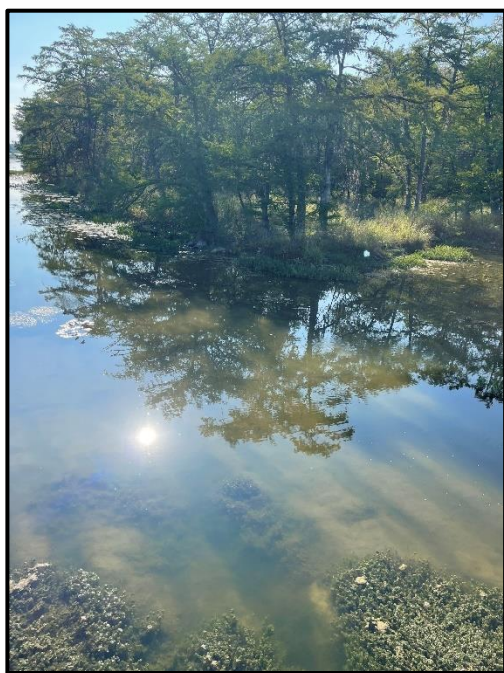
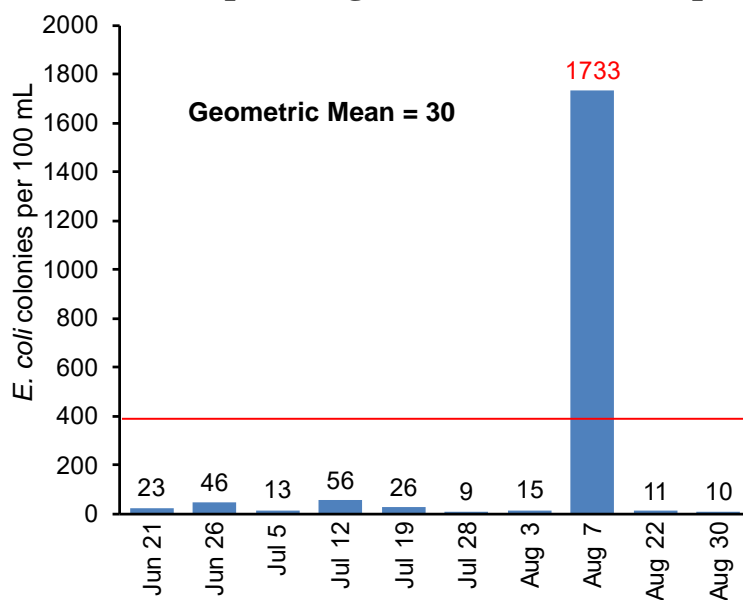
Dee Elliott





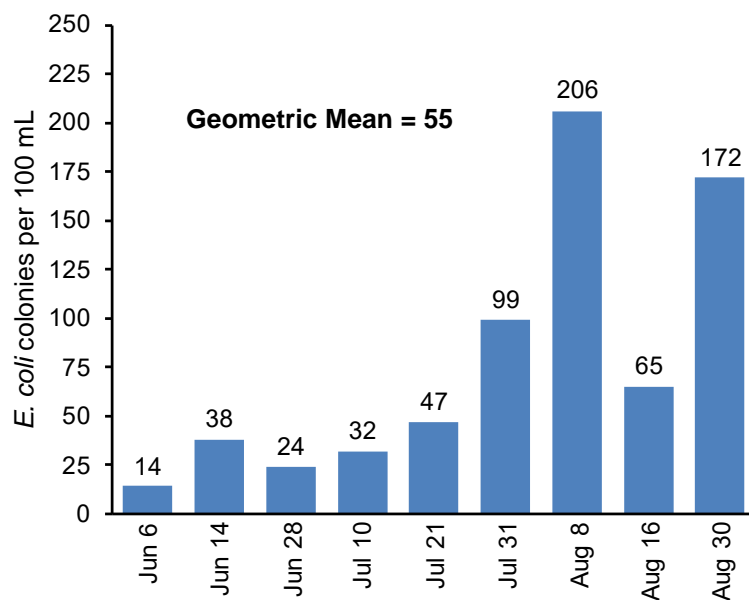
Nellwyn Sadler

### Guadalupe at Ingram Lake Boat Ramp



Alice King

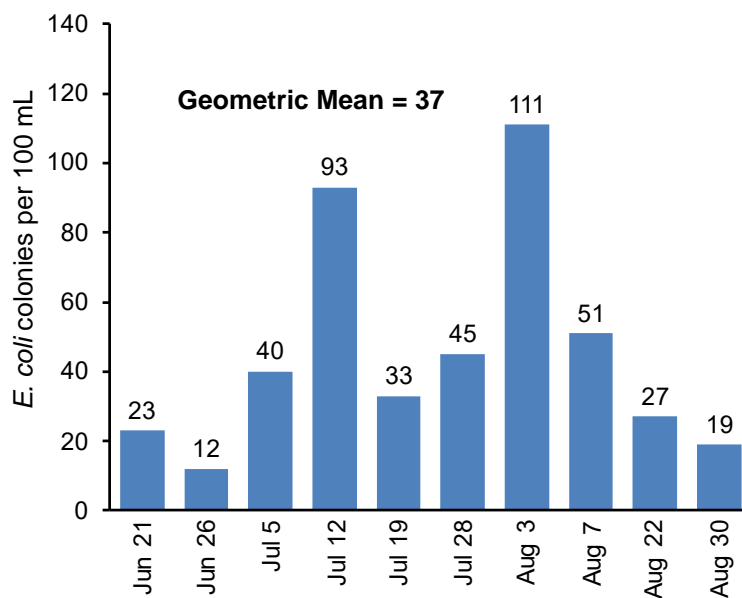
### Guadalupe at Lower Cade Loop





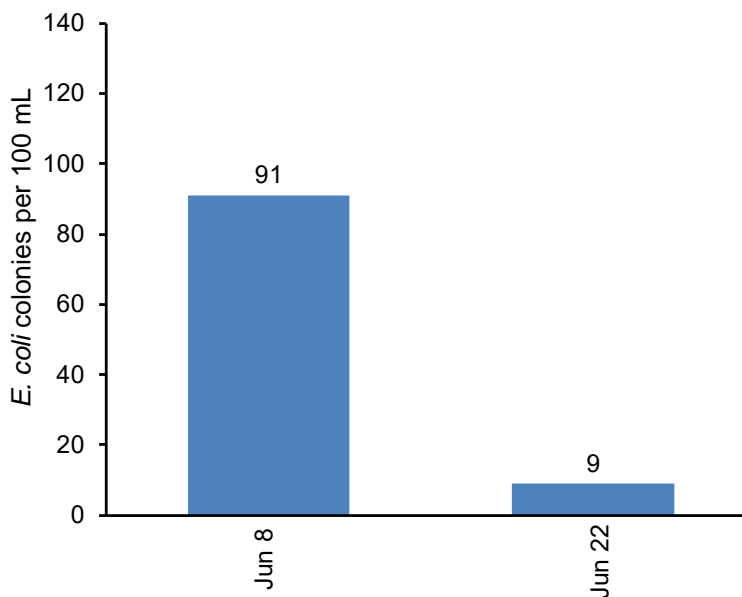
Nellwyn Sadler

### Guadalupe at Indian Creek Rd. Crossing



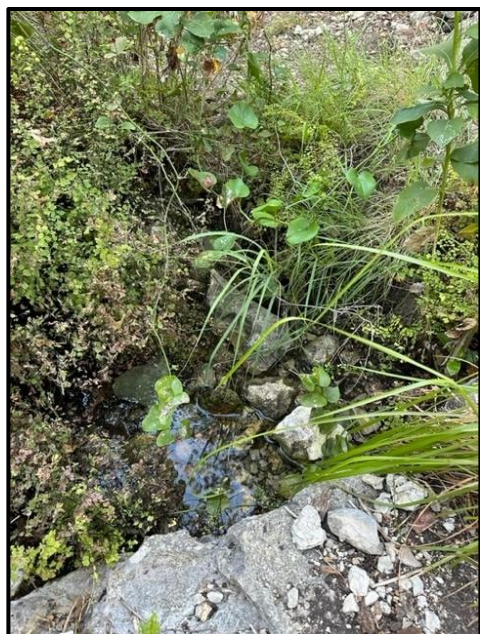
Patrick Andrews

### \*Guadalupe at Ingram Park



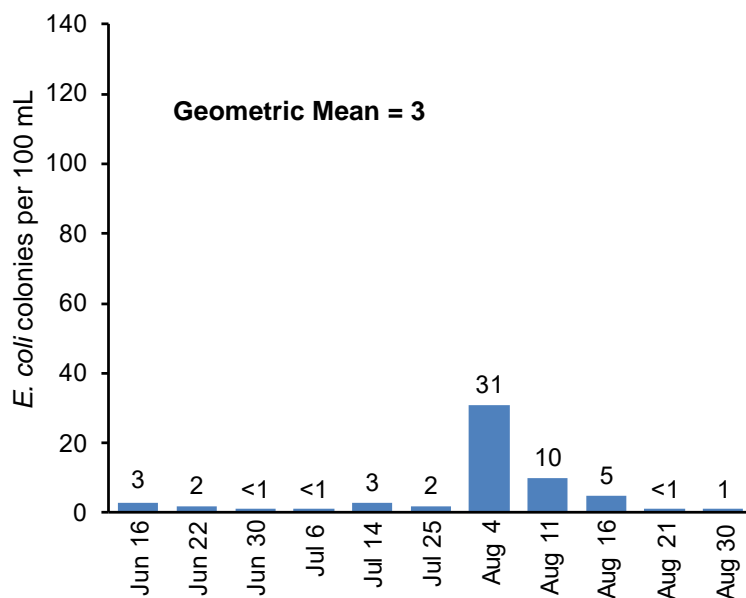
\* Insufficient samples to calculate geometric mean.





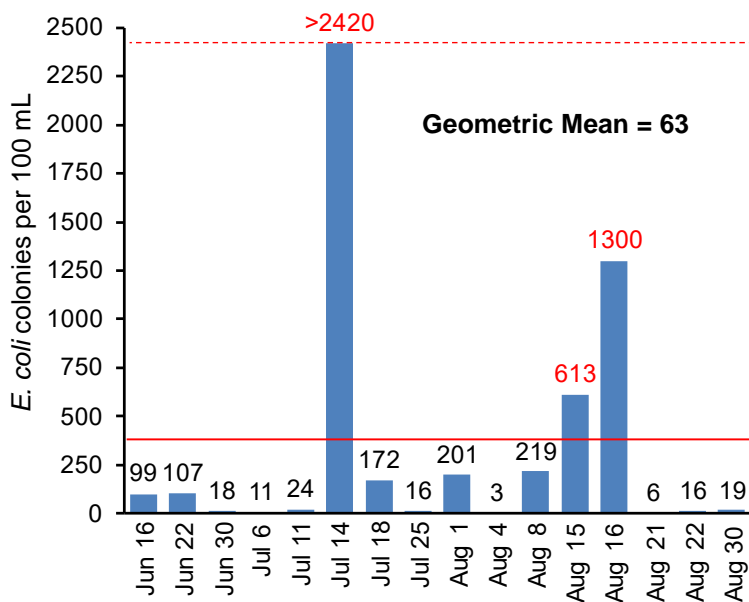
Maura Windlinger

### Goat Creek at Headwaters

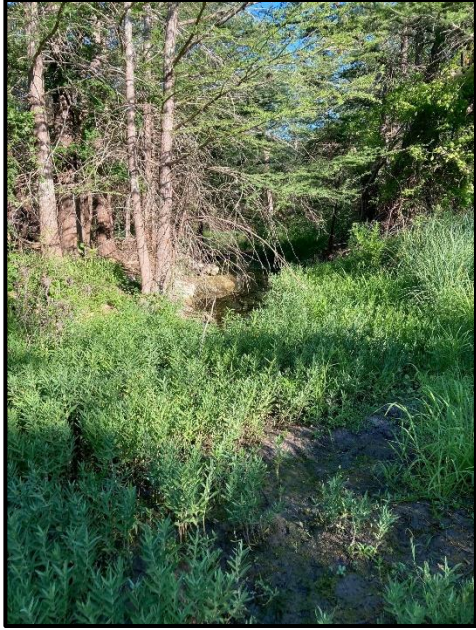


Palmore Baxter / Maura Windlinger

### \*Goat Creek downstream from I-10

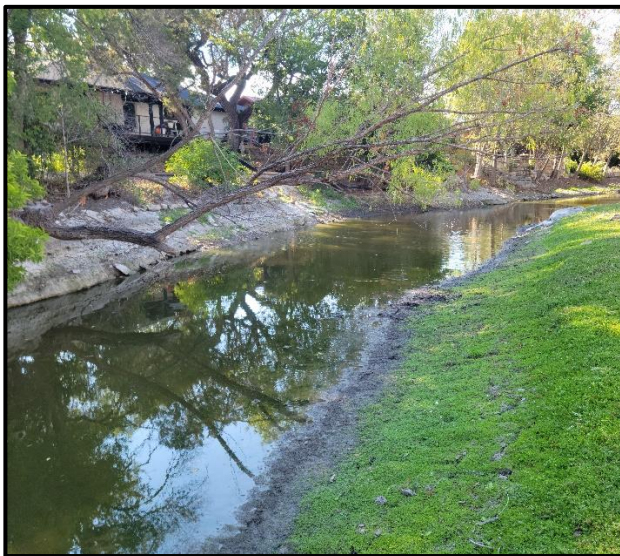
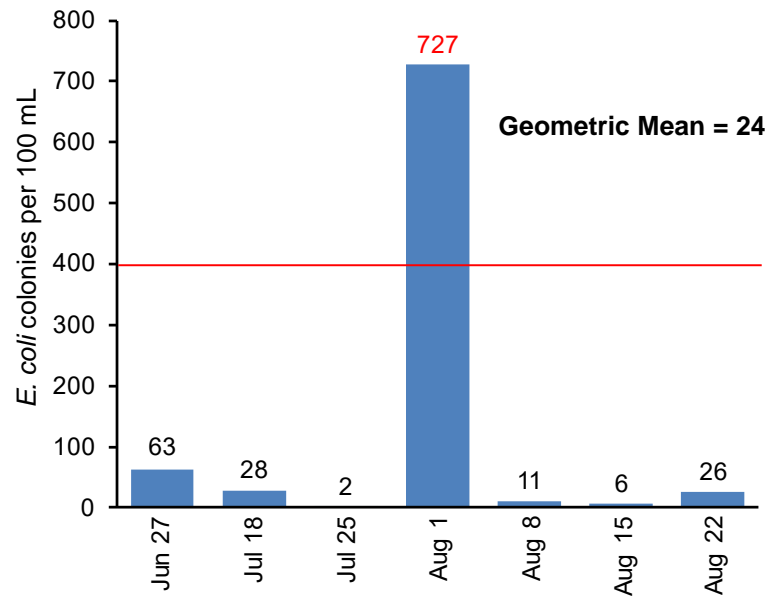


\* Two volunteers sampled this site.



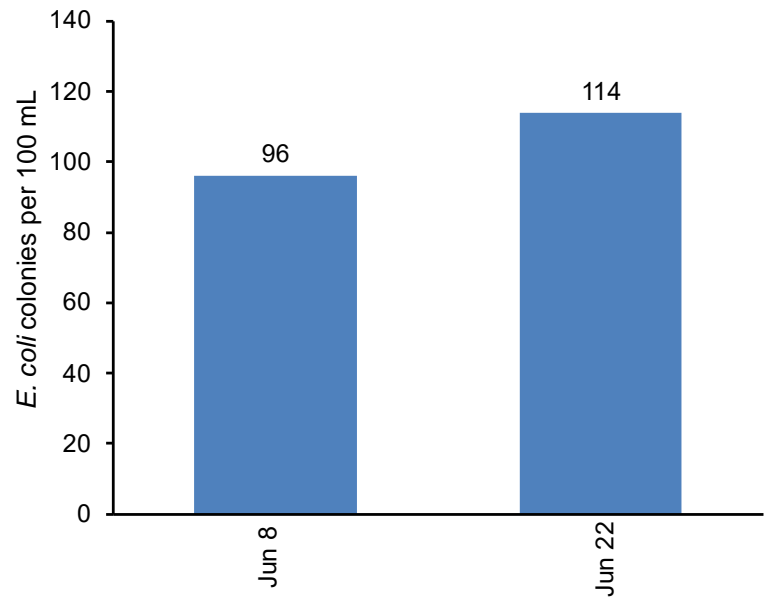
Palmore Baxter

### Goat Creek at KOA



Patrick Andrews

### \*Lime Creek at Lime Creek Apartments



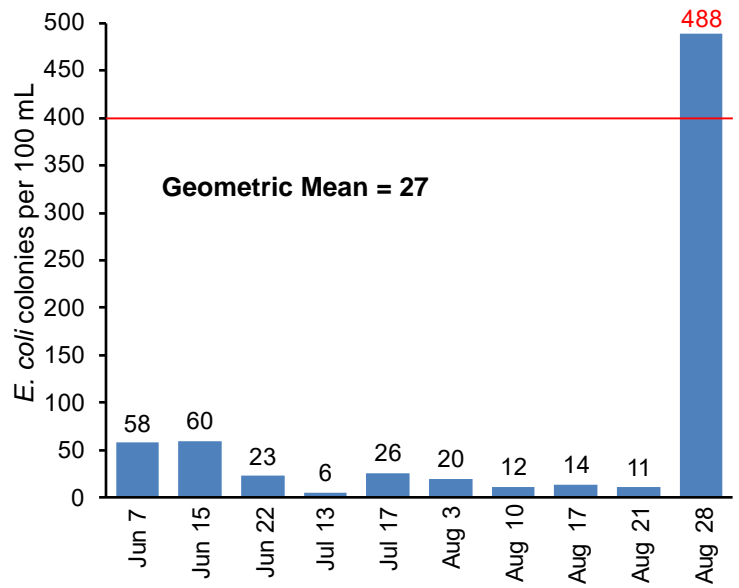
\* Insufficient samples to calculate geometric mean.





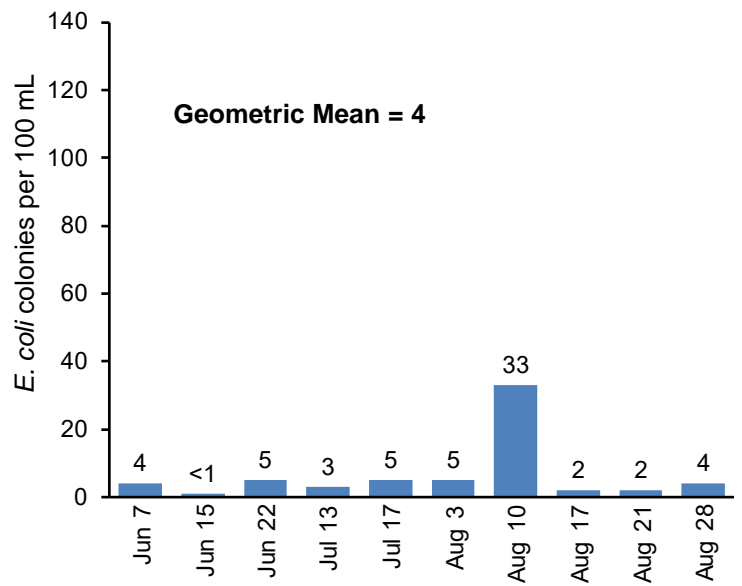
Carl & Katy Kappel

### Guadalupe at Cypress Park (Kayak)



Carl & Katy Kappel

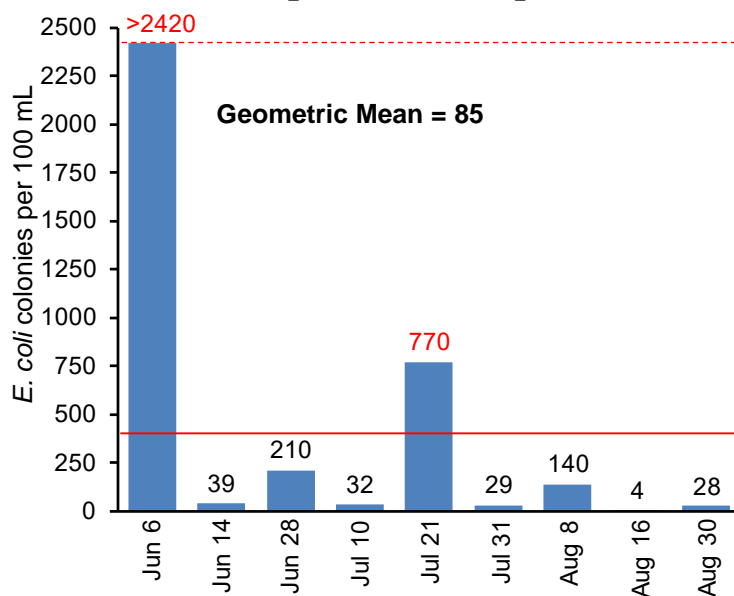
### Guadalupe at Knapp Park (Kayak)





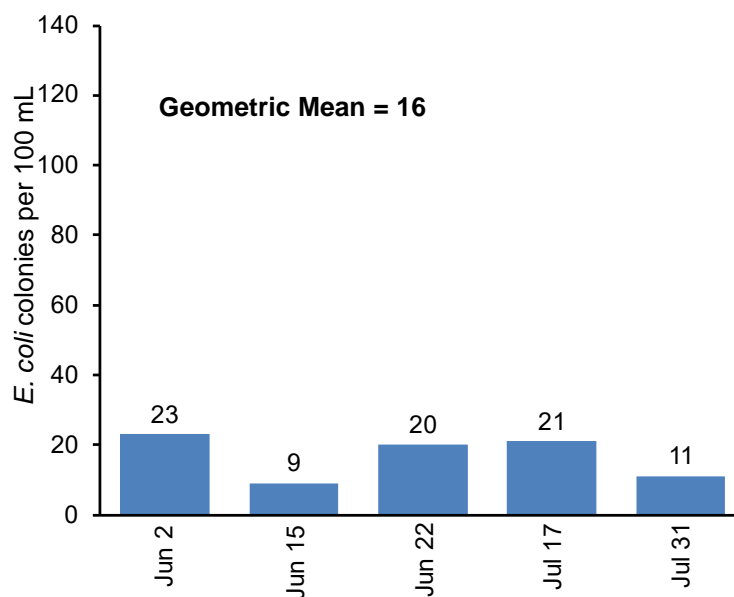
Alice King

### Guadalupe at Guadalupe Park



Phil Youngblood

### \*Town Creek at Town Creek Rd.



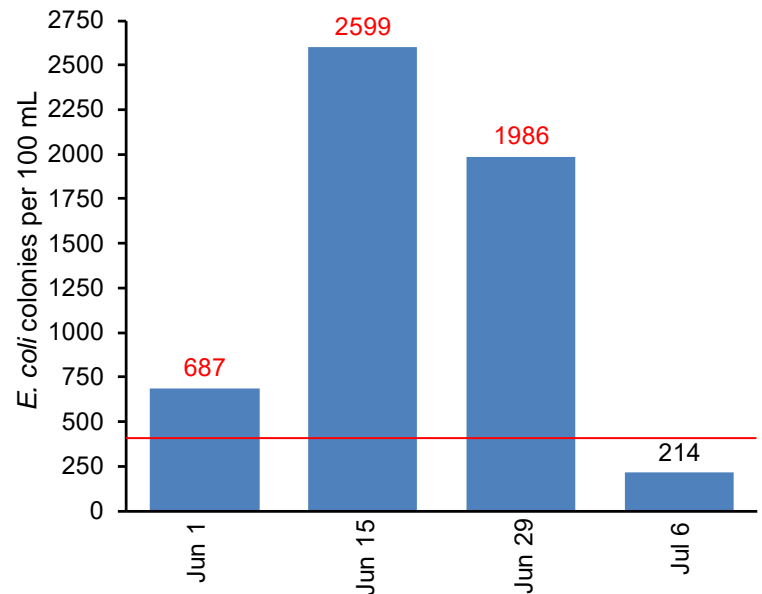
\* Site went dry soon after sample minimum was met.





Trudy Eberhardt

**\*Town Creek at Morris Rd.**

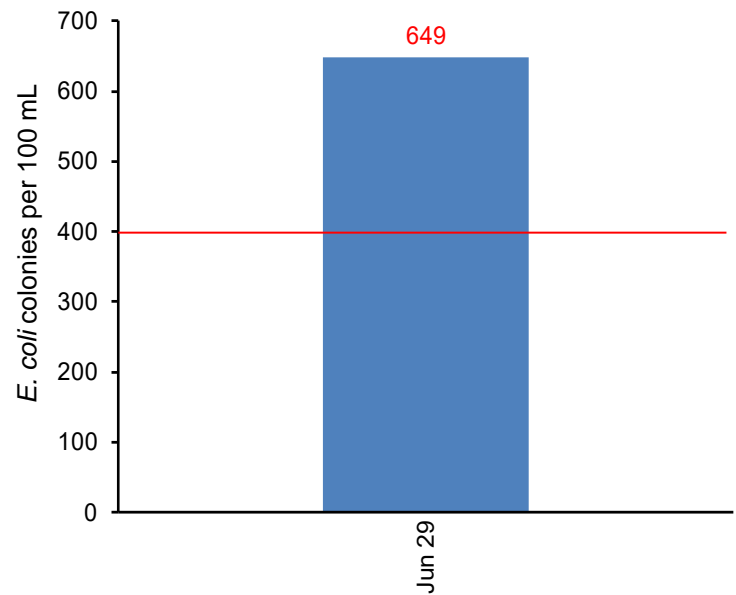


\* Insufficient samples to calculate geometric mean; volunteer's sample site went dry.



Jim Gardner

**\*Town Creek at Guadalupe Cemetery**



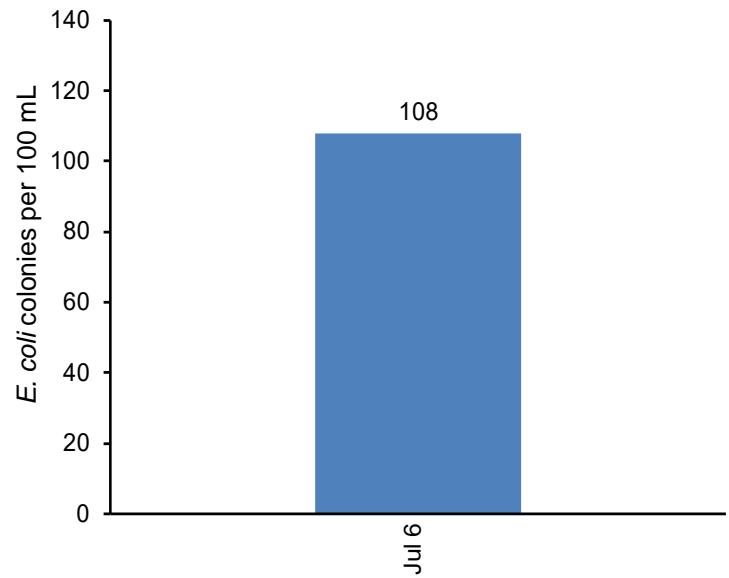
\* Insufficient samples to calculate geometric mean; volunteer's sample site went dry.





Jim Gardner

### \*Town Creek at Schreiner St.

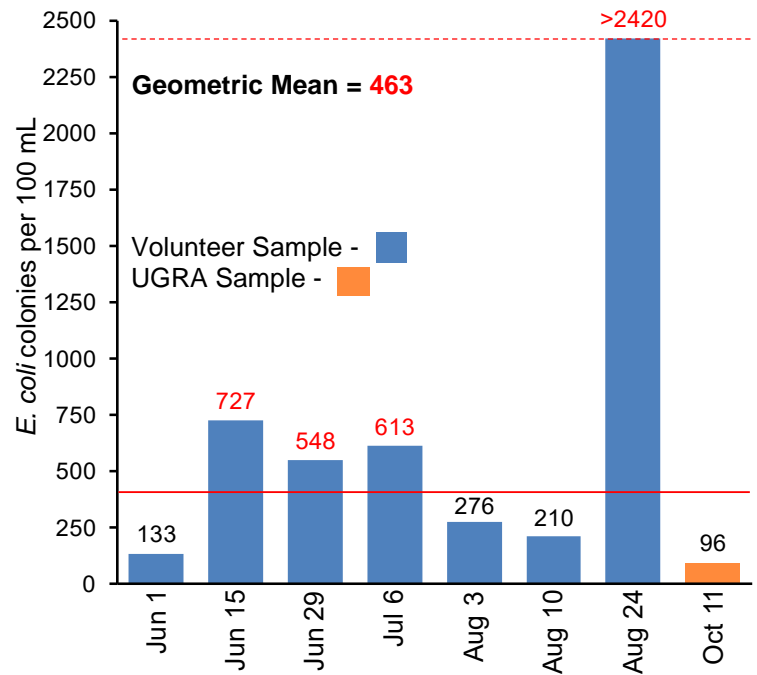


\* Insufficient samples to calculate geometric mean; volunteer's sample site went dry.



Trudy Eberhardt

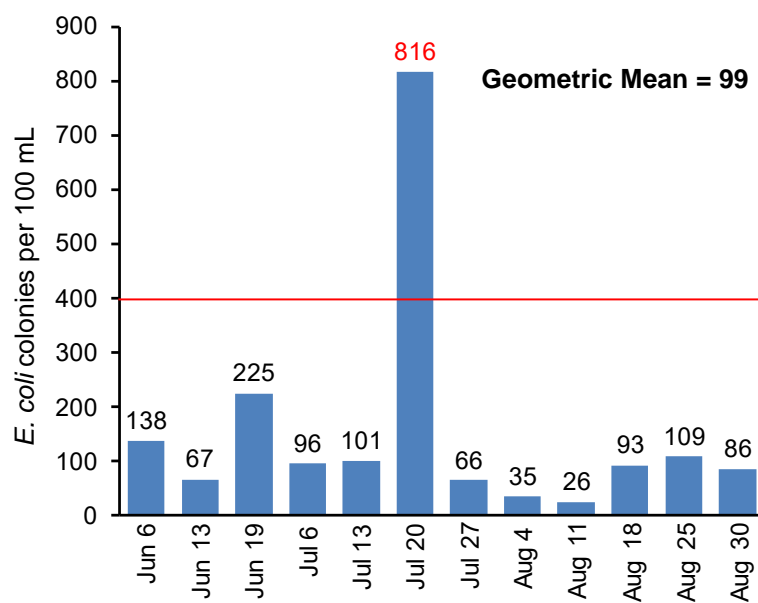
### Guadalupe at Town Creek Confluence





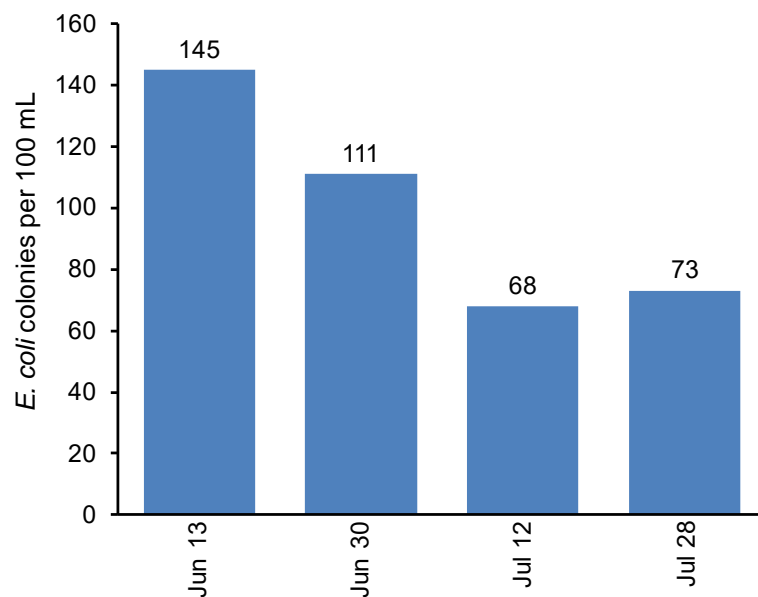
Sherry Wilson

### Guadalupe at Louise Hays Park Footbridge



Larry Hesketh

### \*Guadalupe at Rio Robles

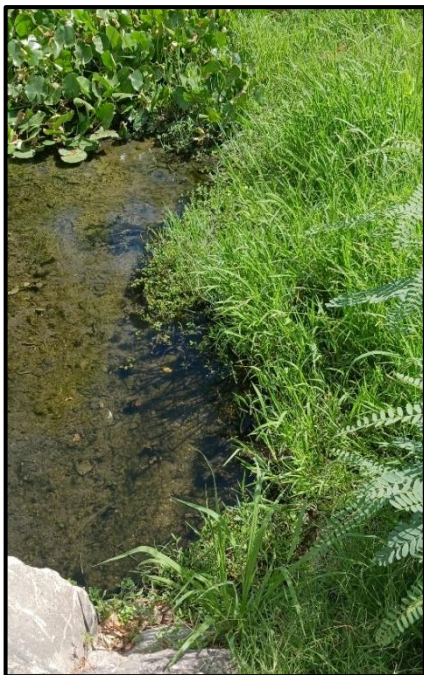
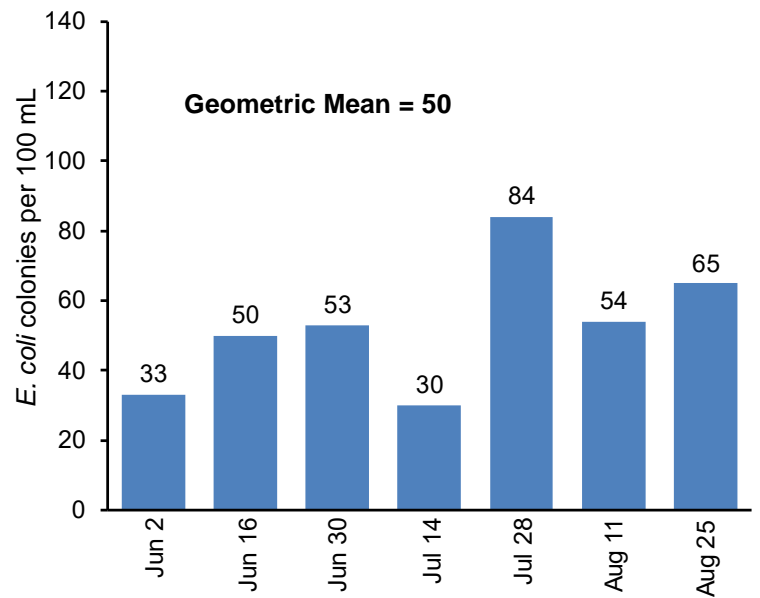


\* Insufficient samples to calculate geometric mean.



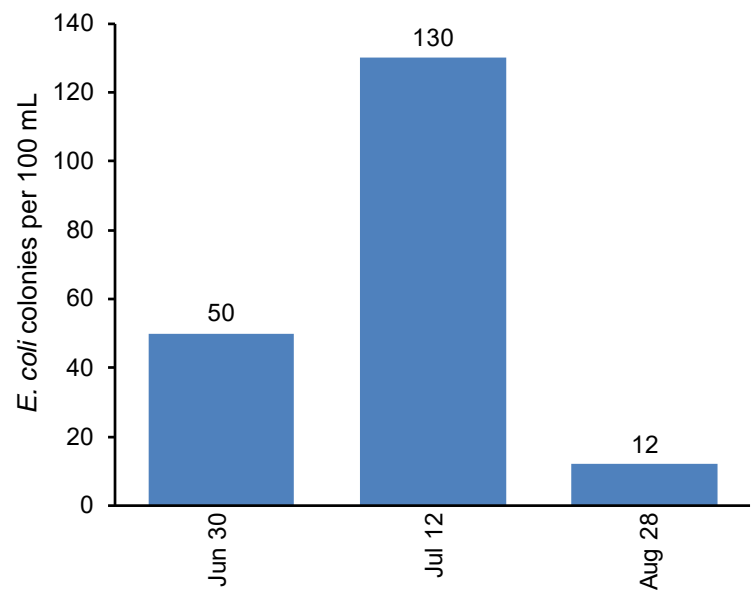
Deb Youngblood

### Guadalupe at G St.



Larry Hesketh

### \*Quinlan Creek at Habitat Park



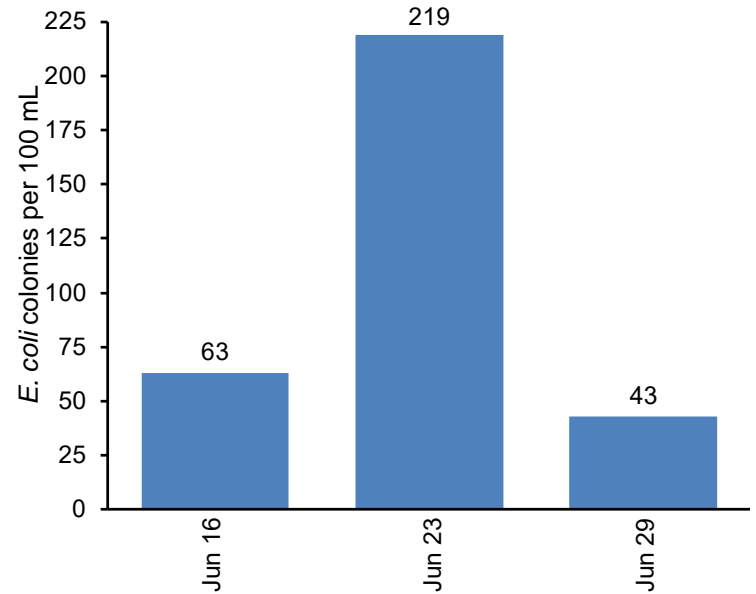
\* Insufficient samples to calculate geometric mean.





Lizbeth Lopez

**\*Quinlan Creek at Hwy. 27**

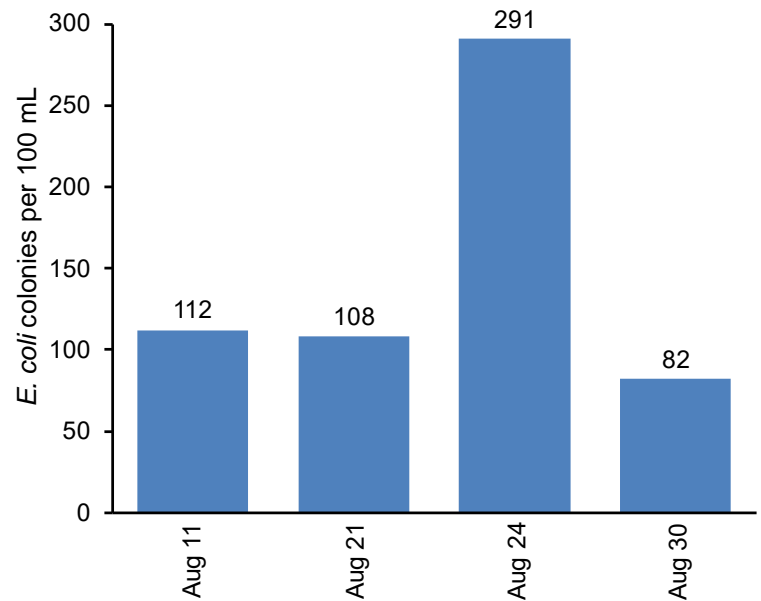


\* Insufficient samples to calculate geometric mean.

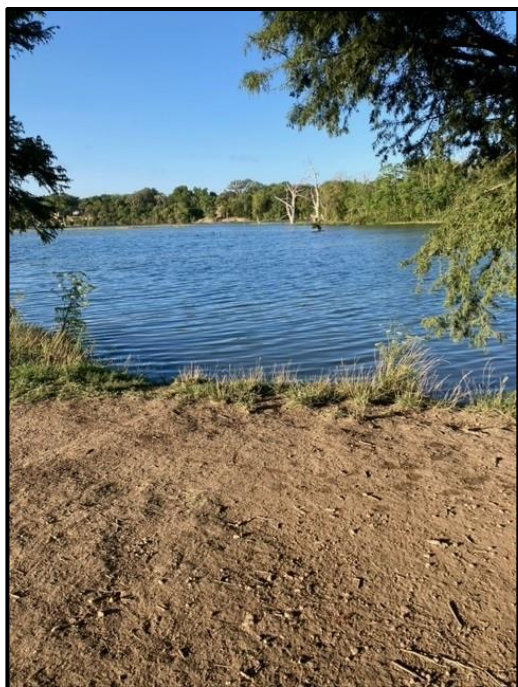


Jim Gardner

**\*Guadalupe at Flat Rock Lake Boat Ramp**

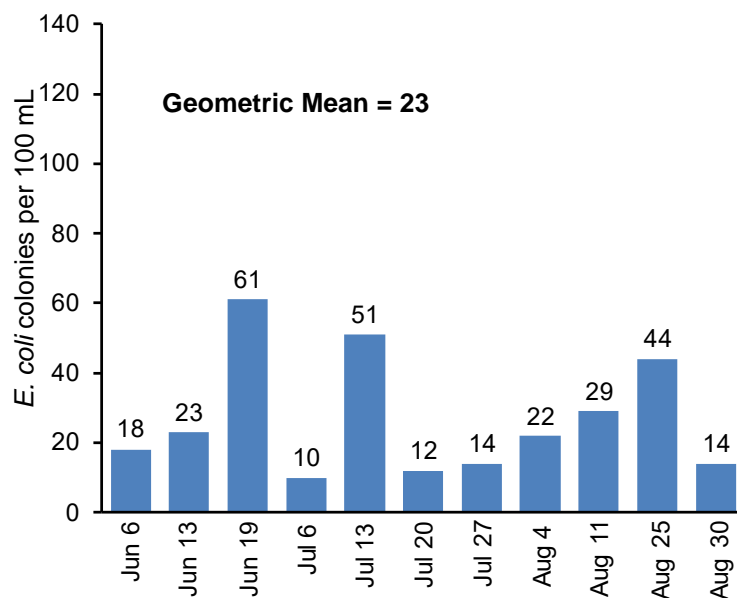


\* Insufficient samples to calculate geometric mean; volunteer relocated late in sampling period.



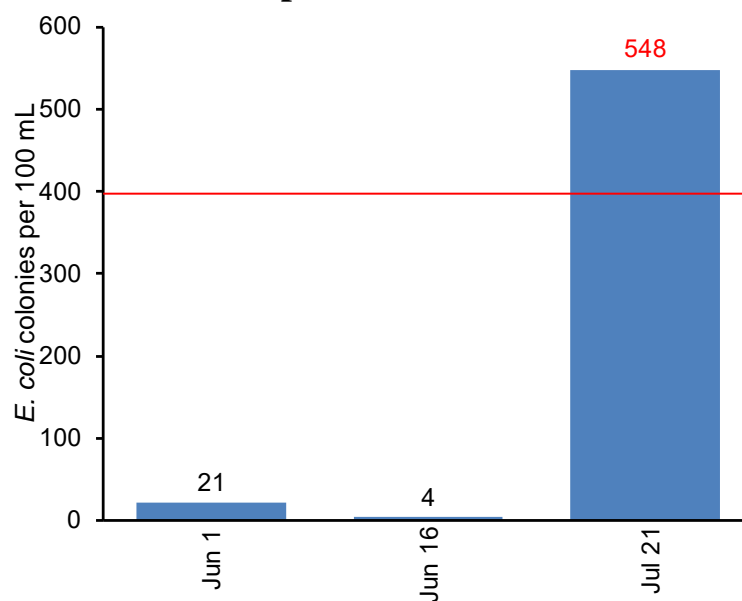
Sherry Wilson

### Guadalupe at Flat Rock Park Dog Park



Clark Williams

### \*Guadalupe Below Flat Rock Dam



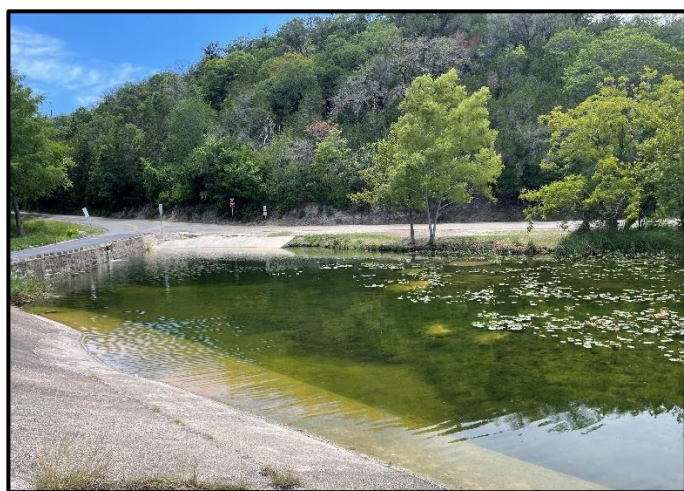
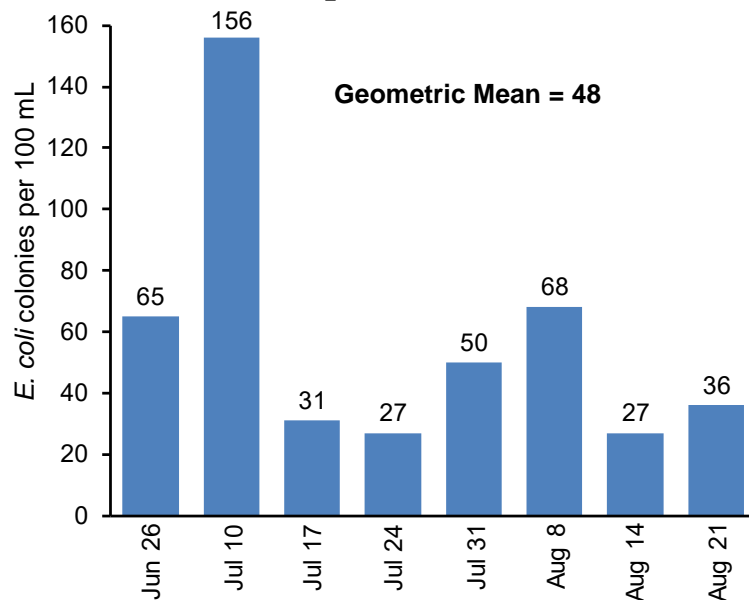
\* Insufficient samples to calculate geometric mean; volunteer's sample site went dry.





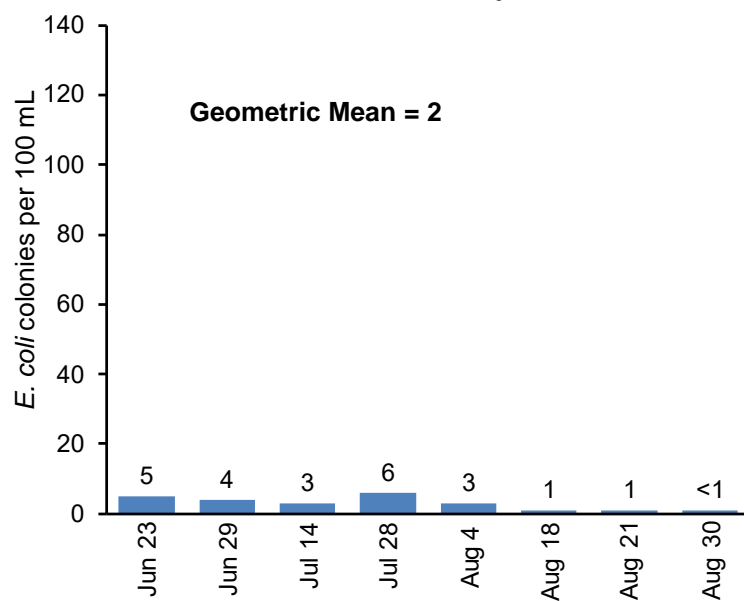
John Hornung

### Guadalupe at Wharton Rd.



Kathy Loring

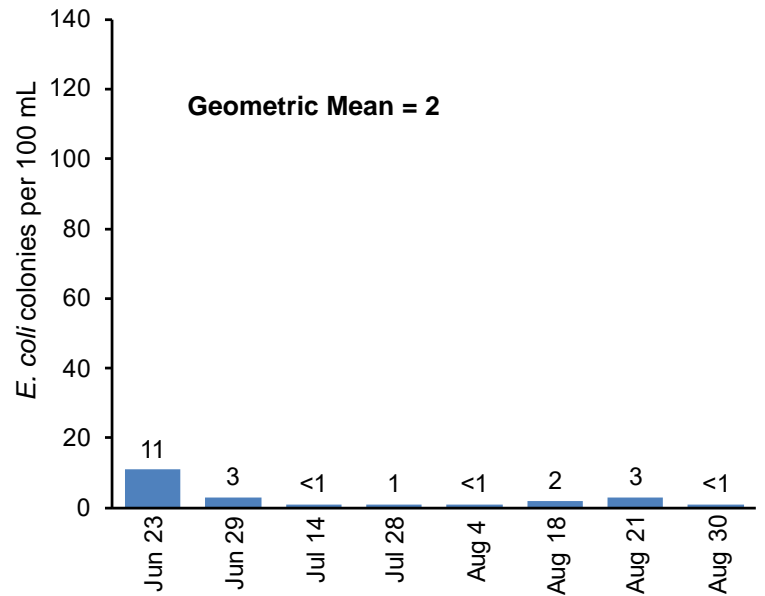
### Turtle Creek at Rocky Hill Dr.





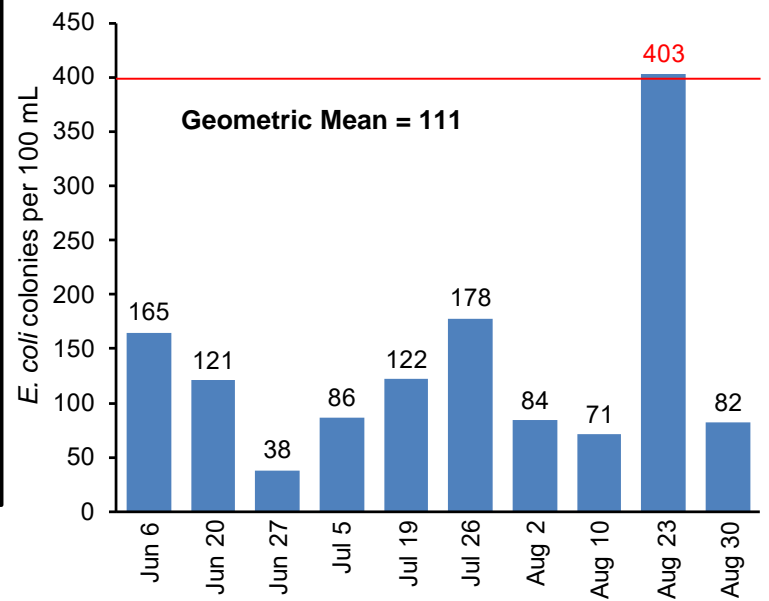
Kathy Loring

### Turtle Creek at Fall Creek Rd.



Patricia Higgins

### Guadalupe at Government Crossing

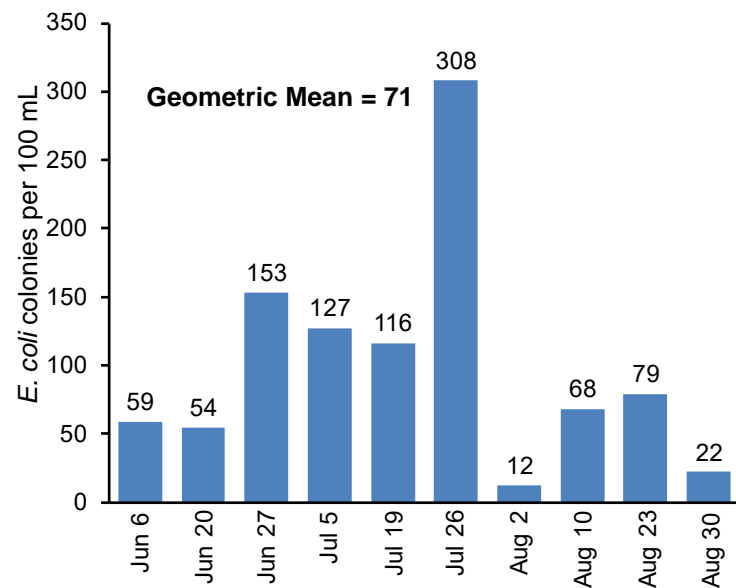






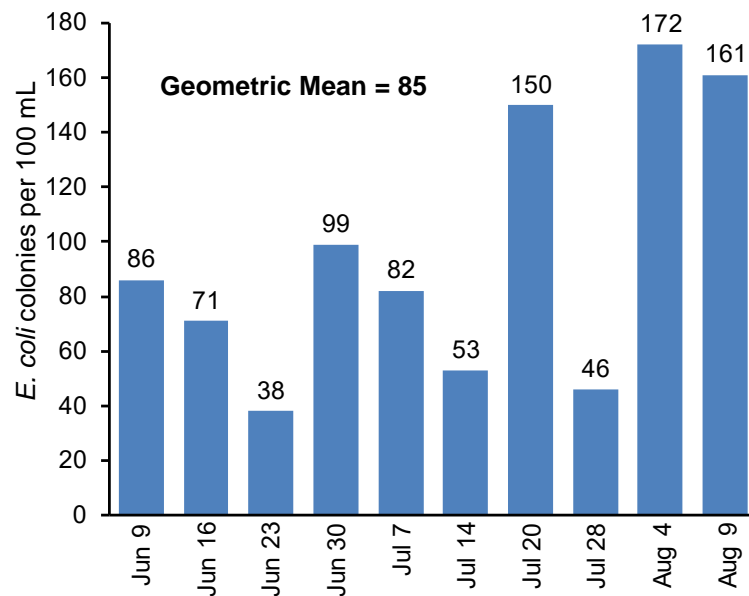
Patricia Higgins

### Guadalupe at Verde Creek Confluence



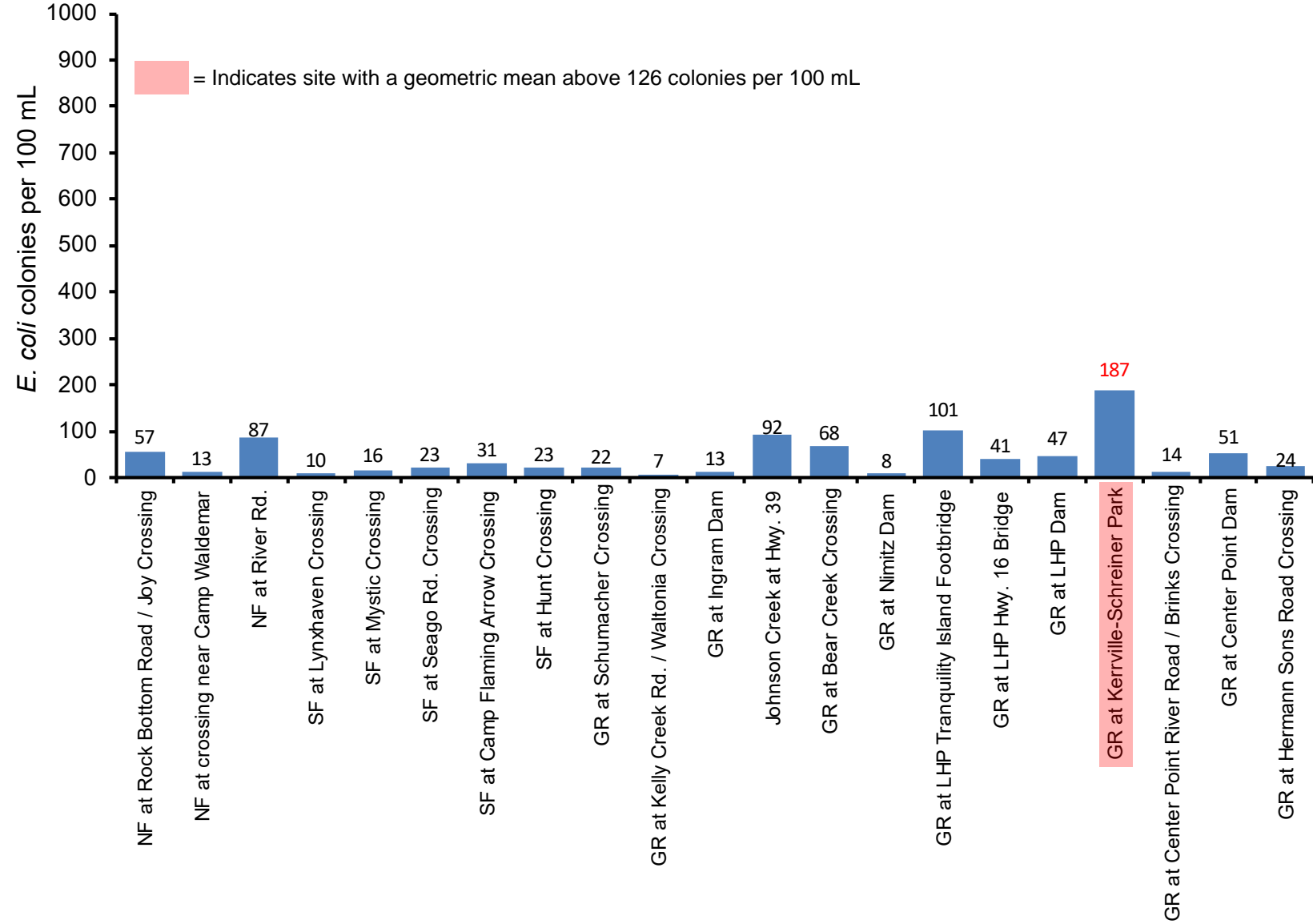
Paz Lovett

### Guadalupe Upstream of Lane Valley

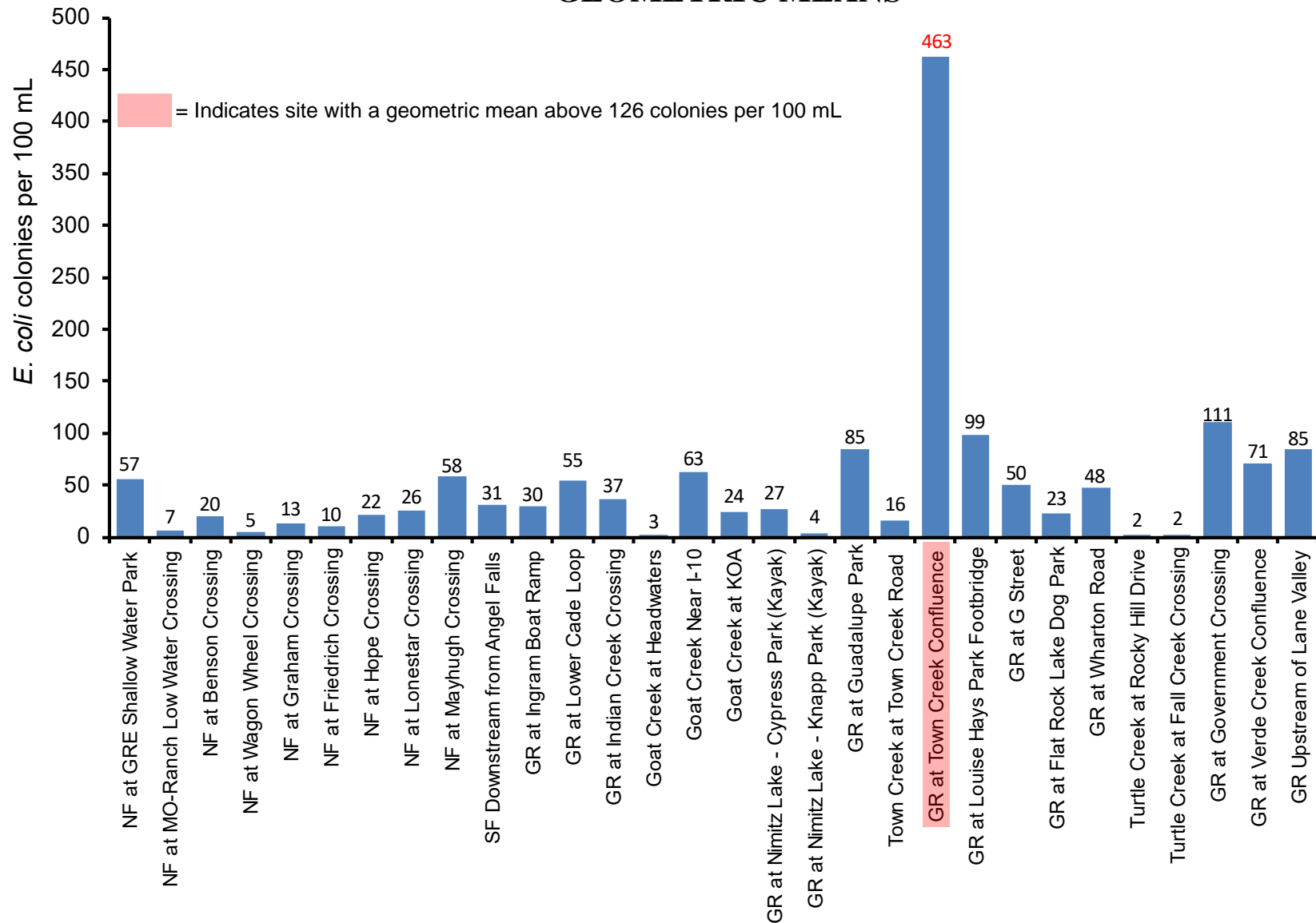




# SUMMER SWIMABILITY STUDY GEOMETRIC MEAN



## VOLUNTEER SUMMER STUDY GEOMETRIC MEANS



**Great job volunteers!! Thank you for all your hard work and we hope you will participate in UGRA's Volunteer Summer Study next year.**