E.coli and Nutrients in Brazos County Carter Creek Subcatchments

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Introduction

A high level of bacteria is the most common cause of impairment to Texas freshwater creeks (EPA 303(d) list). Carter Creek in Brazos County and several of its sub-catchments are on the list for bacterial impairment. Rainfall flushes large quantities of bacteria into surface waters, particularly in urban areas. The release of nitrogen and phosphorus from municipal waste water treatment plants can possibly sustain and increase bacterial populations, potentially affecting the quality of surface waters (Bolster et al., 2005).

Objectives

Provide a snapshot of *E. coli* and nutrients in Carter Creek subcatchments

Identify correlations between nutrient concentrations and *E. coli* population densities in Carter Creek subcatchments

Materials and Methods

Sampling and Preparation

Fifteen grab samples were collected in sterile Whirl-pak bags biweekly from Carter Creek sub-catchments within Brazos County. Samples were transported back to the laboratory on ice.

E.coli – EPA Method 1603

Within 6 h of collection, samples were filtered through 0.45 µm membrane filters and plated on modified m-TEC agar. The plates were incubated at 35 ± 0.5°C for 2 h and then at 44.5 ± 0.2°C for 22-24 h. Each magenta colony after 24 h was counted as one colony forming unit (CFU).

Nutrients

Samples were filtered through ashed Whatman GF/F (nominal pore size 0.7 µm) filters for dissolved organic carbon (DOC), total dissolved nitrogen (TDN) and ammonium (NH_4) through 0.2 µm (Pall Acrodisc) filters for analysis of anions. Samples were then frozen until analysis.

DOC and TDN were analyzed using a Shimadzu TOC-V_{CSH} with nitrogen detector. Ammonium-N and Nitrate-N were quantified using a Westco Scientific Smartchem Discrete Analyzer. Anions, fluoride (F^-), chloride (Cl^-), bromide (Br^-), nitrite (NO_2^-) and sulfate (SO_4^{2-}) were quantified by Dionex 2000 ion chromatography.

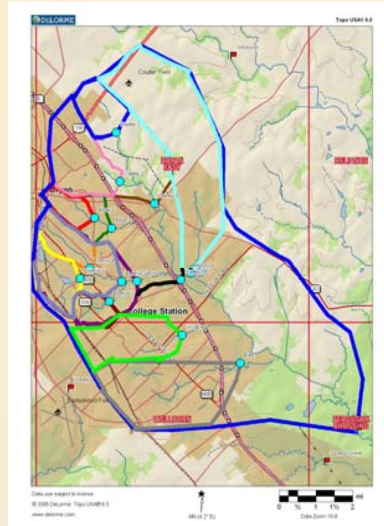

Figure 1: Sub-catchments and sampling sites in Carter Creek watershed.

Table 1: Averaged low-flow and single high-flow events for analyzed nutrients from each sampling site. Dashed nutrients have not yet been analyzed. Units are mg/L.

Site	Flow	DOC	TDN	Fl	Cl	SO_4	PO_4	NH_4
Bee Crk	L	37.19	1.37	0.26	66.23	83.93	0.48	0.23
	H	13.73	1.16	0.10	22.82	29.63	0.62	0.04
Briar 1	L	58.09	1.24	0.28	39.53	21.63	0.68	0.03
	H	10.00	0.86	0.06	8.23	5.29	0.80	0.02
Briar 2	L	29.43	2.43	0.14	12.79	6.76	0.56	0.08
	H	7.89	0.73	0.05	7.36	4.62	0.73	ND
Burton 1	L	38.26	1.08	0.26	28.09	40.77	0.48	0.02
	H	9.84	0.83	0.10	11.21	5.56	0.74	0.01
Burton 2	L	44.93	1.30	0.26	33.11	39.97	0.32	0.03
	H	11.03	0.99	0.10	8.87	5.24	0.92	0.08
Burton 3	L	40.91	0.90	0.22	41.29	40.49	0.49	0.05
	H	11.02	1.12	0.07	9.12	8.25	0.93	0.06
Burton 4	L	42.96	1.17	0.19	28.92	15.30	0.79	0.06
	H	11.04	0.92	0.06	7.69	3.90	0.97	0.41
Burton 5	L	32.66	1.03	0.21	24.50	49.82	0.56	0.04
	H	10.57	0.92	0.16	13.31	29.63	0.96	0.34
Carter UD	L	24.14	0.66	0.13	15.72	13.99	0.40	0.07
	H	7.80	0.83	0.10	7.17	5.33	0.61	0.06
Carter 1	L	40.16	2.58	0.24	31.98	35.78	0.36	0.17
	H	11.04	0.84	0.12	11.68	7.65	0.49	---
Carter 2	L	40.92	2.15	0.13	11.53	9.70	0.23	0.12
	H	2.81	0.58	0.03	2.61	2.18	ND	
Carter 3	L	51.44	11.35	0.83	71.82	64.18	4.69	0.05
	H	10.71	0.98	0.06	14.20	8.43	0.73	---
Carter WDF	L	46.46	11.47	0.68	61.31	58.66	5.64	0.07
Hudson	L	48.08	1.40	0.59	32.30	66.85	1.75	0.06
	H	10.06	0.75	0.07	7.18	5.11	0.63	0.05
Wolfpen	L	70.17	1.10	0.48	71.83	70.81	1.47	0.06
	H	130.34	0.85	---	---	---	---	0.03

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Results and Discussion

E. coli

- Burton 2 contributes largest load to Carter (avg. 13,075 CFU/100 mL)
- Wolfpen Creek contributes the least (avg. 596 CFU/100 mL)
- Sampling sites downstream from WWTPs displayed no significant increase in bacterial numbers compared to the other sampling sites
- Rainfall events trigger dramatic spikes in bacterial counts (Fig. 2)
- Percentage of shrubby rangeland are significantly related to *E. coli* counts, indicating a contribution from livestock and wildlife (Fig. 3)

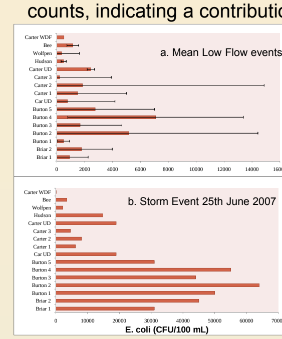

Figure 2. *E. coli* counts a) average low and b) one storm event in June 2007. Error bars are 1 standard deviation.

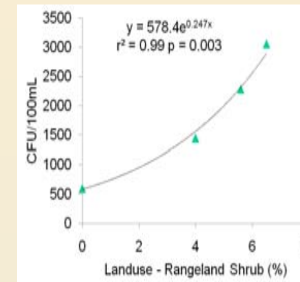

Figure 3. Relationship between mean *E.coli* counts and % rangeland shrub-scrub in Carter (UD), Hudson, Bee and Wolfpen Creeks.

Nutrients

- Rain increased orthophosphate but diluted other nutrients (Table 1)
- Carter UD & Carter WDF had higher TDN and PO_4 than other sites
  - Downstream of WWTPs - release of nutrient-laden effluent
  - Land disturbance from development upstream of Carter UD
- Nitrite and bromide were at trace levels or not detected

Conclusions

- *E. coli* in Carter Creek significantly related with % rangeland
- No significant relationships found between nutrients and *E. coli*
- Storm flow yields higher concentrations of *E. coli* and PO_4 while diluting other nutrients

Further Research

As this study progresses, we plan to analyze samples for nitrate-N and calculate dissolved organic nitrogen (DON). We will also examine nutrient roles in bacterial recovery after WWTP disinfection. In the meantime, we will continue to sample Carter Creek sub-catchments including more rain events for a period of one full year.

References

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