Little Bay Stakeholder Meeting

Anna Gitter, Nicole Powers, Lucas Gregory, and Shay Postma

5/7/2024

Texas Water Resources Institute
make every drop count

UTHealth Houston | School of Public Health

Texas A&M University Corpus Christi

Texas A&M AgriLife

Texas Coastal Management Program

NOAA

Agenda

- Introductions
- Recap of previous meeting
- Present updated results
- Discuss implications of updated analysis

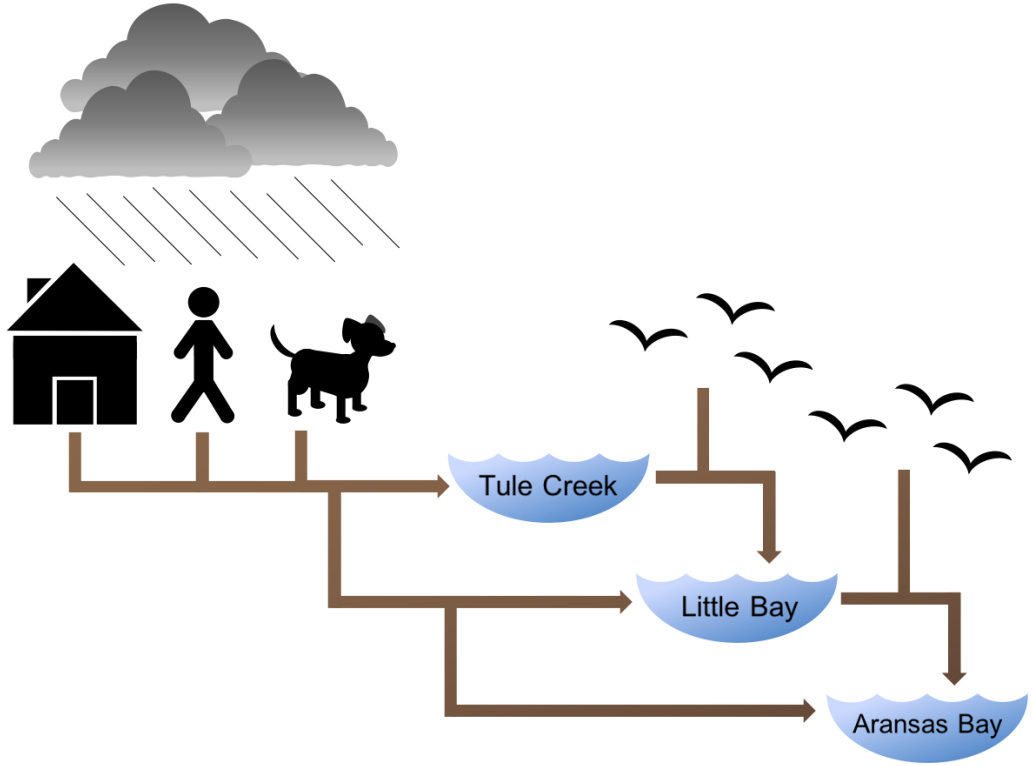
Recap of Previous Meeting

- Discussed history of water quality
- Previous microbial source tracking project
- Preliminary risk assessment results
- Discussion and feedback
  - Include jet skiing and boating in risk assessment
  - Closer look at locations (Little Bay vs. Tule Creek) and weather/stormwater influence (wet-loading vs. dry-loading)

Previous Study

High enterococci levels detected in Little Bay- where is the bacteria coming from?

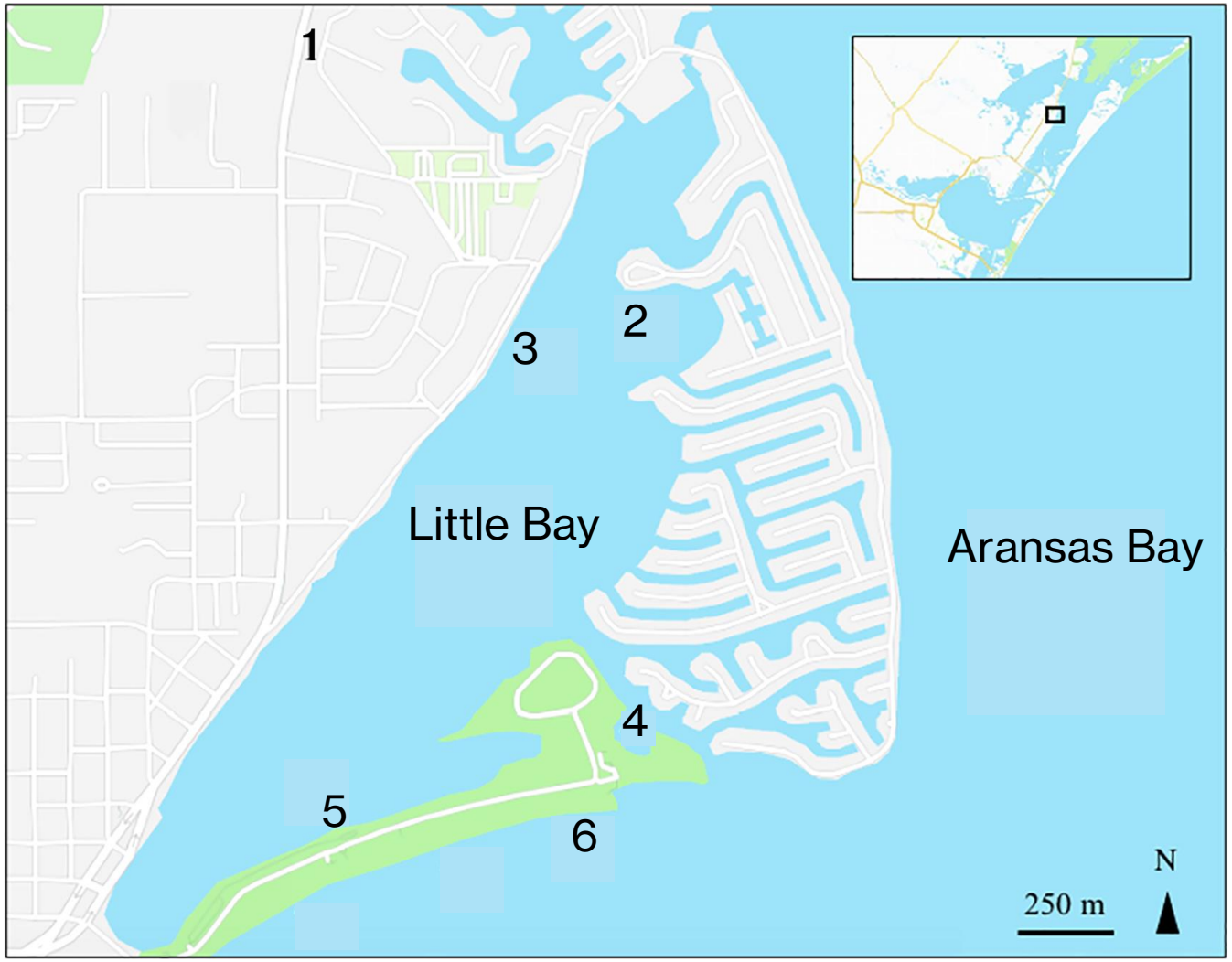
1) Are humans, dogs, and/or gulls contributing to fecal contamination in Little Bay?
2) Are fecal markers higher after rainfall (wet-loading) or dry periods (dry-loading)?
3) Are fecal markers higher in Tule Creek, Little Bay, or Aransas Bay?



Map

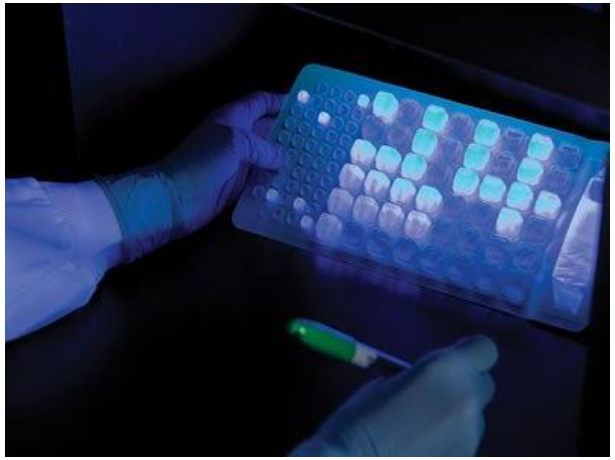
Site No.	Site Name	Latitude (°N)	Longitude (°W)
1	Tule Creek	28.050315	-97.042832
2	Key Allegro Pace Dock	28.043616	-97.032572
3	Tule Creek Outfall	28.043116	-97.035877
4	Rockport Saltwater Pool	28.032564	-97.033296
5	Little Bay Ski Basin	28.030435	-97.039682
6	Rockport Beach Park North	29.030580	-97.034047

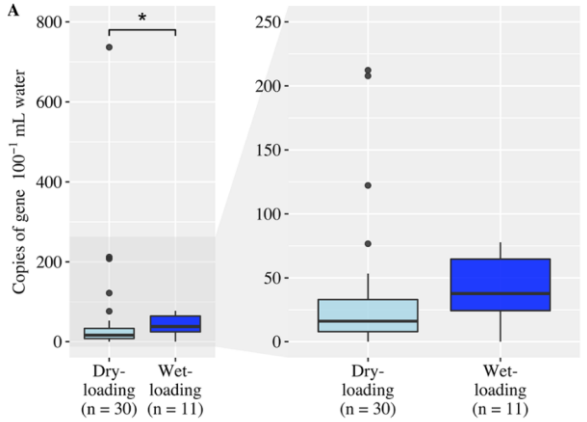

(Photo credit: CBBEP)



Methods

Water sampling → Measure enterococci → Quantify fecal markers → Data analysis





Enterococci Results

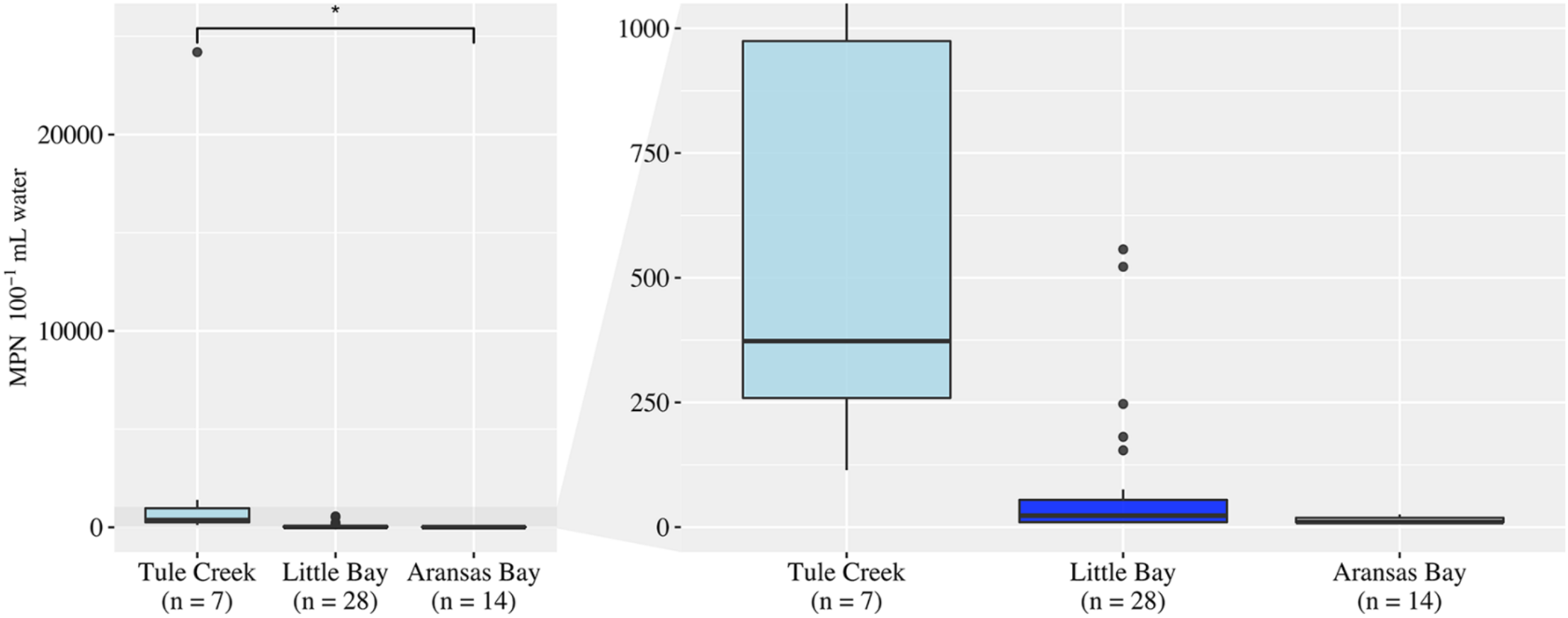
Question 1

Were enterococci higher after rainfall? **No**

Question 2

Were enterococci higher in Tule Creek? **Yes**

Enterococci Results

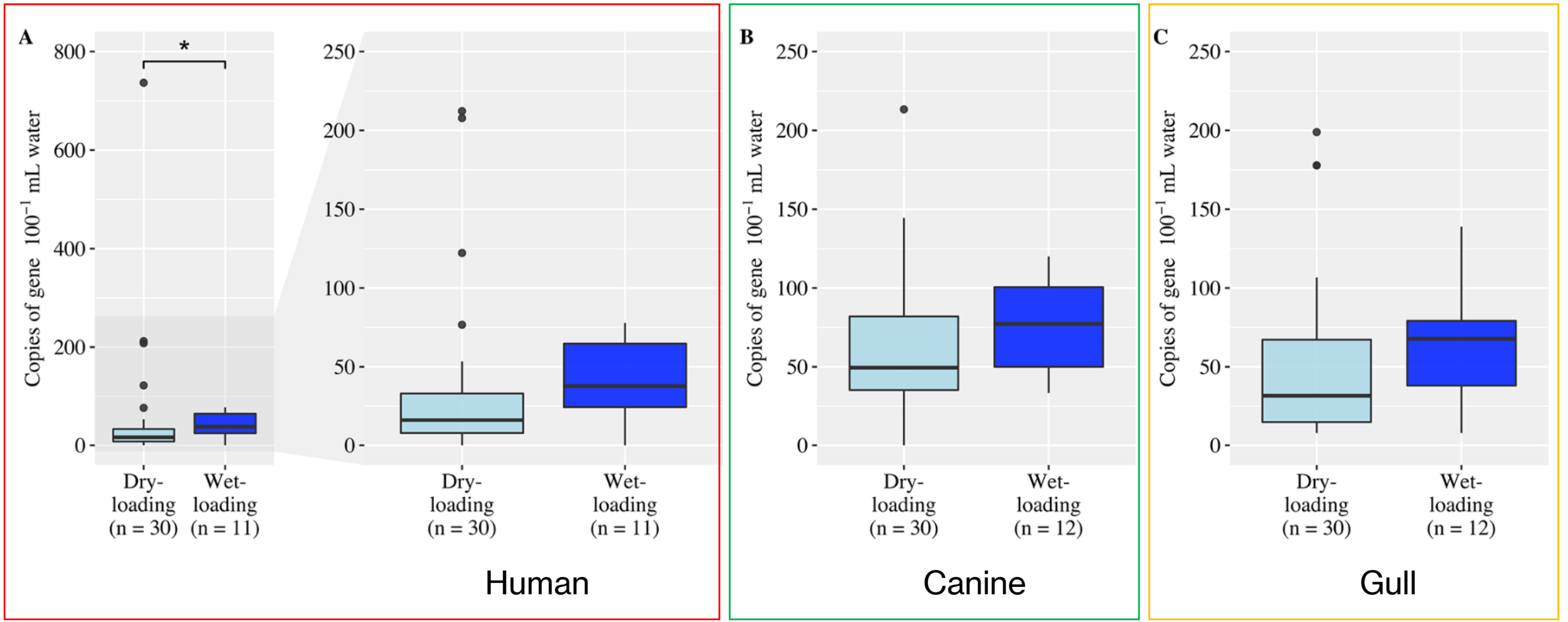


Microbial Source Tracking Results

Question 1 Were fecal markers higher after rainfall? **Yes***

Question 2 Were fecal markers higher in Tule Creek? **No**

Microbial Source Tracking Results



Implications

Enterococci were highest in Tule Creek but were not higher after rainfall during this study.

- Tule Creek could be a potential source of enterococci or it could be enriching environmental enterococci.

The human marker was not higher in Tule Creek, but it was generally elevated after rainfall.

- Stormwater runoff could be one source of the human marker.
- Additional spikes in the human marker were recorded after dry-loading.

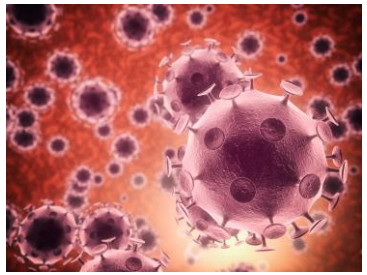
Enterococci were not correlated with the fecal markers.

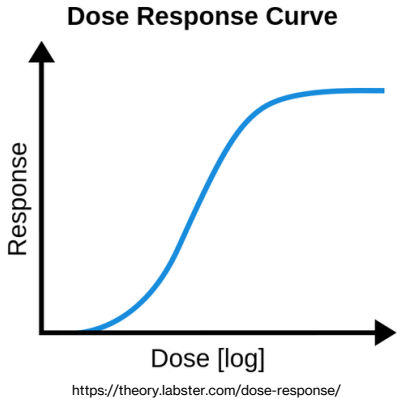
- Most of the enterococci likely originated from a different source.

Human Health Risk Assessment

Human Health Risk Assessment

Hazard Identification → Exposure Assessment → Dose-Response → Risk Characterization

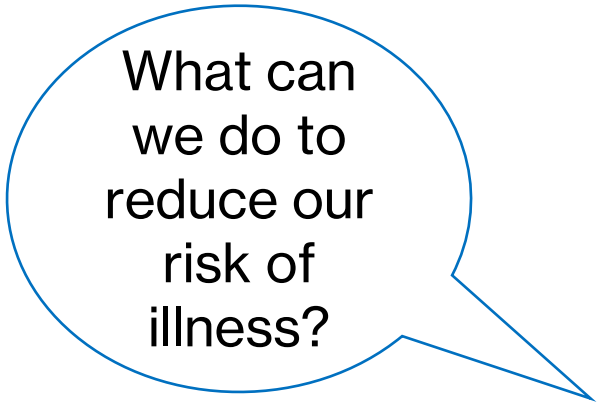


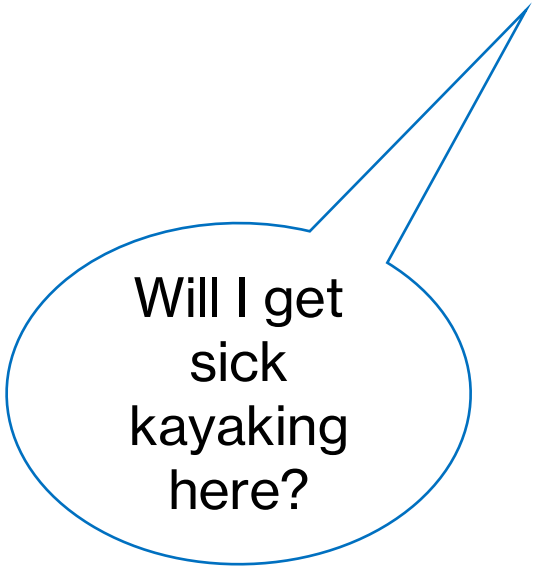


https://theory.labster.com/dose-response/

Human Health Risk Assessment

Can be used to help answer questions regarding safety and exposure risks.





U.S. EPA Risk Threshold for Contact Recreation:
32 illnesses per 1,000 individuals (0.032)

Exposure Scenarios

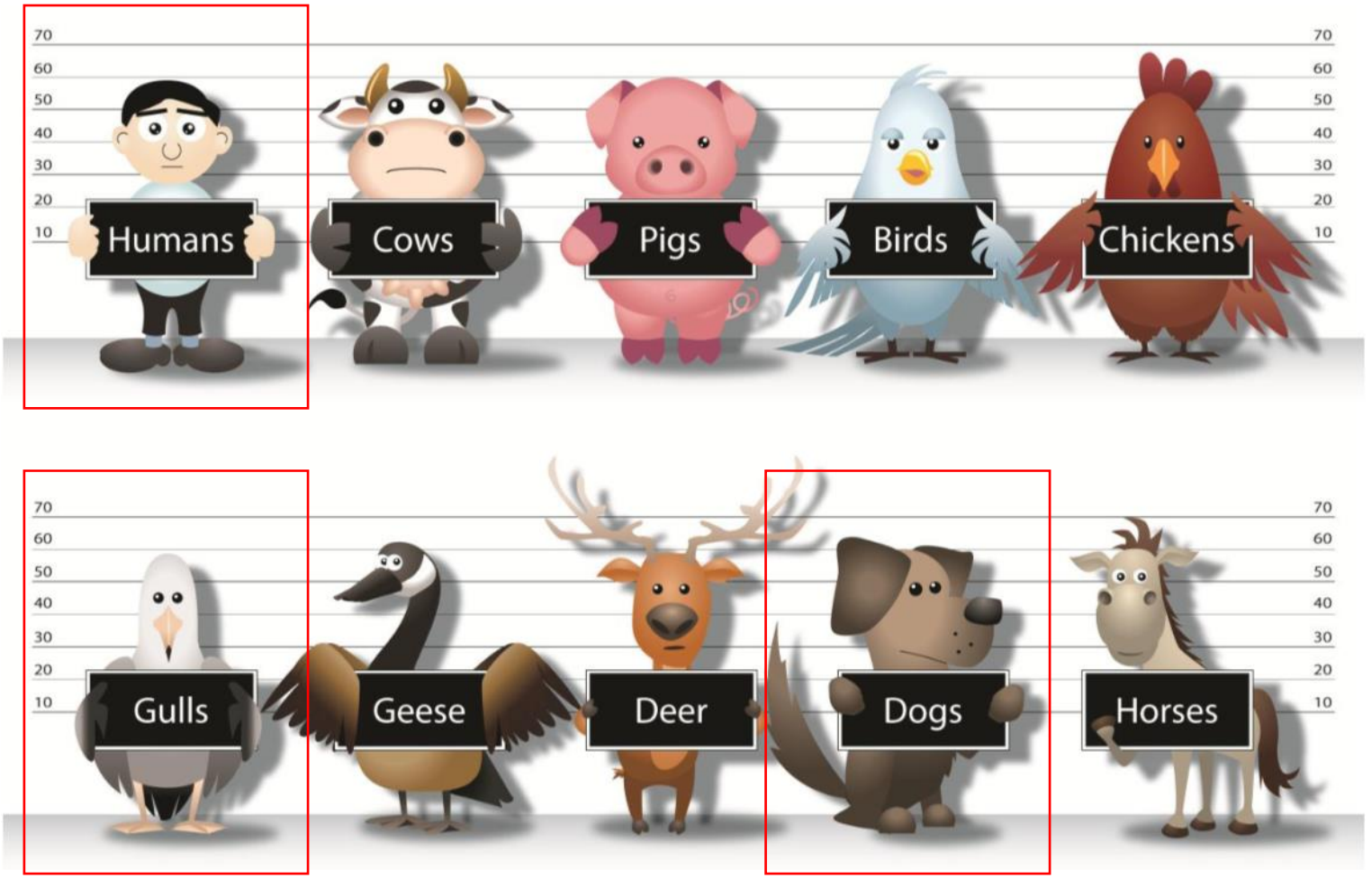
- Swimming (adults and children)
- Kayaking (adults only)
- Fishing (adults only)
- Boating (adults only)
- Jet skiing (adults only)

Risk Assessment Results

1) All MST data combined (human, canine, gull)
2) Wet-loading vs. dry-loading
3) Tule Creek vs. Little Bay vs. Aransas Bay
4) Enterococci

Risk Assessment:

Microbial Source Tracking Data



(Source Molecular, 2012)

Red line = 32 illnesses per 1,000 people

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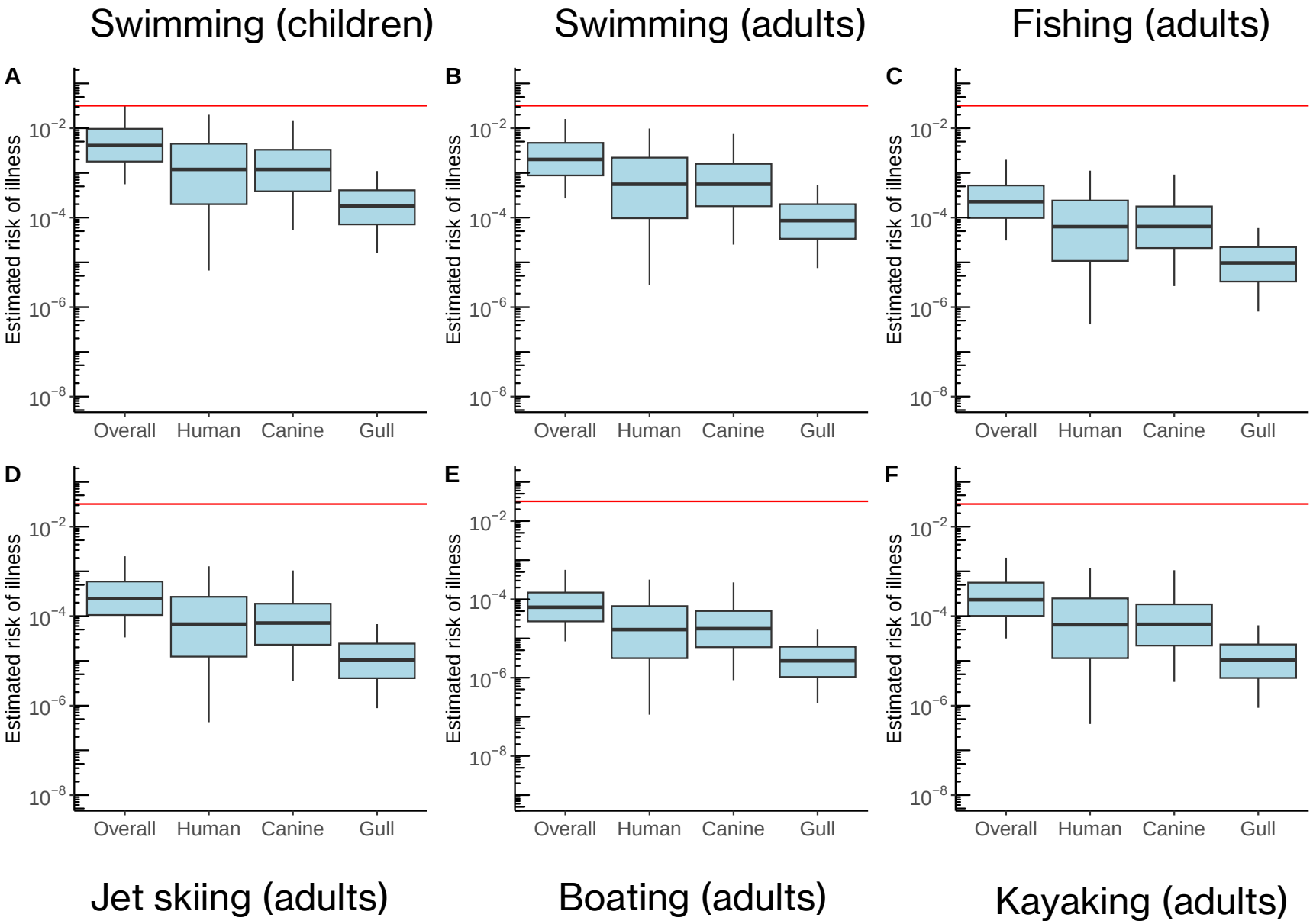
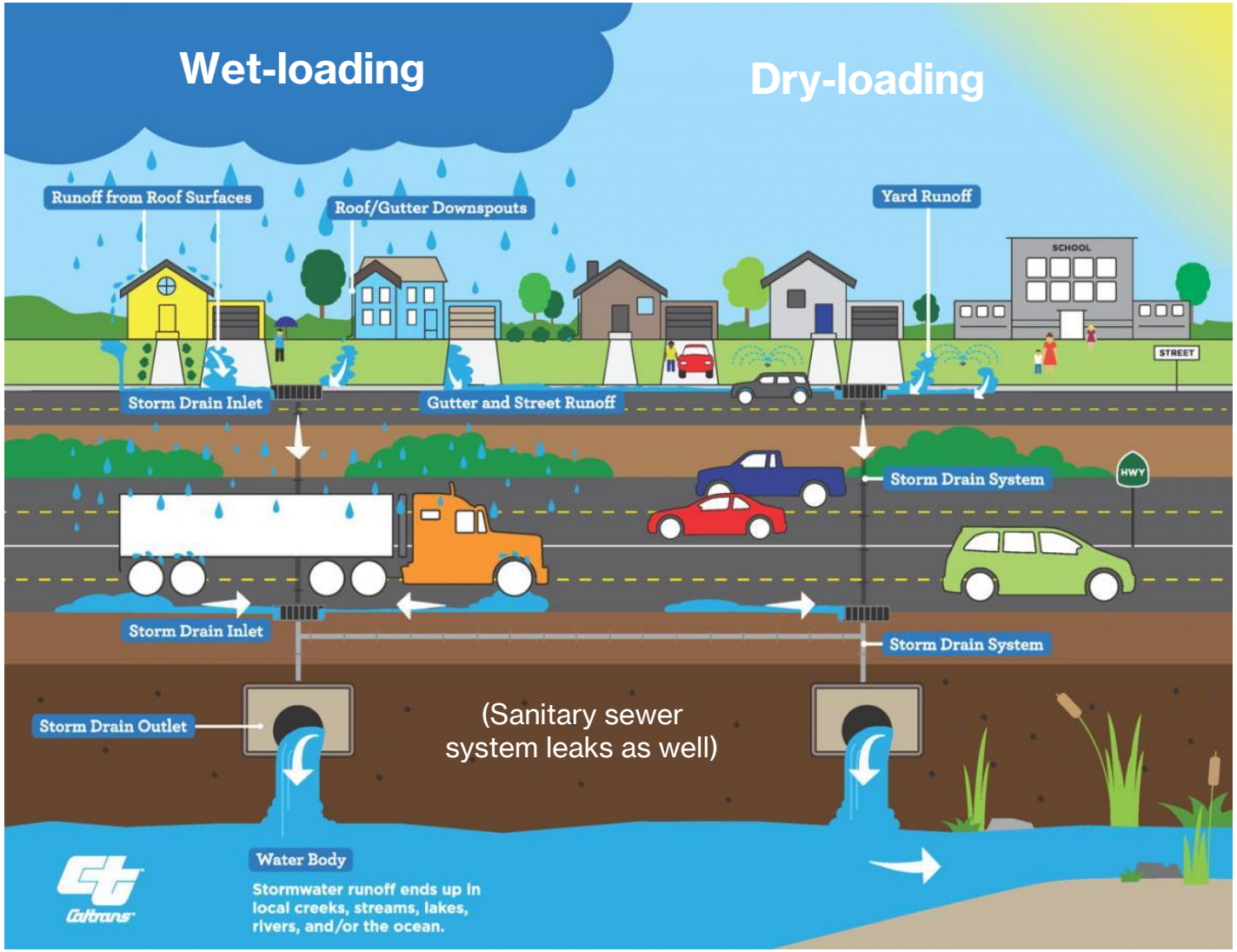


Risk Assessment:

Wet-loading

vs.

Dry-loading



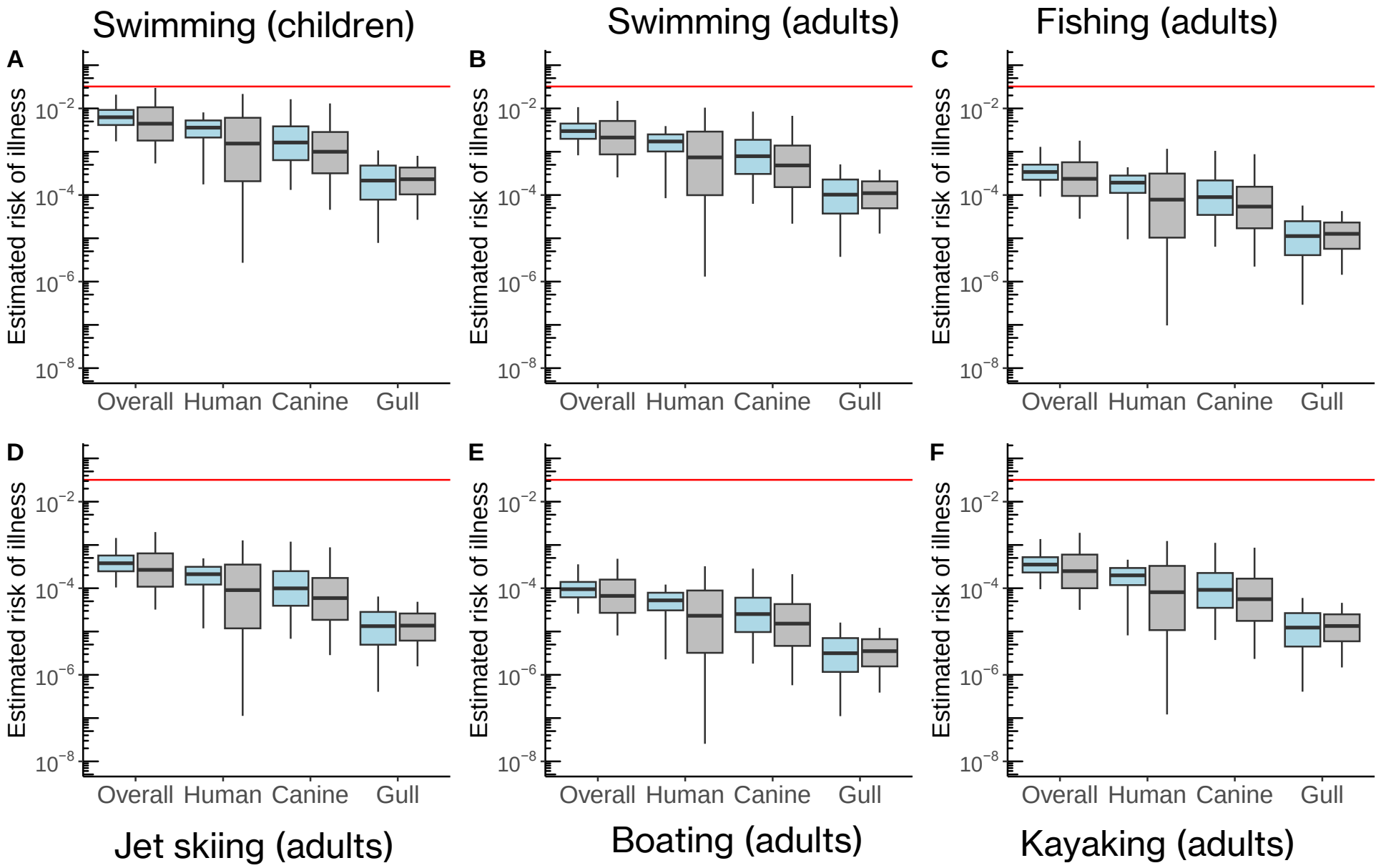
(Contra Costa Clean Water Program)

Red line = 32 illnesses per 1,000 people

Weather conditions Wet–loading Dry–loading

Red line = 32 illnesses per 1,000 people

Weather conditions — Wet–loading — Dry–loading



Risk Assessment:

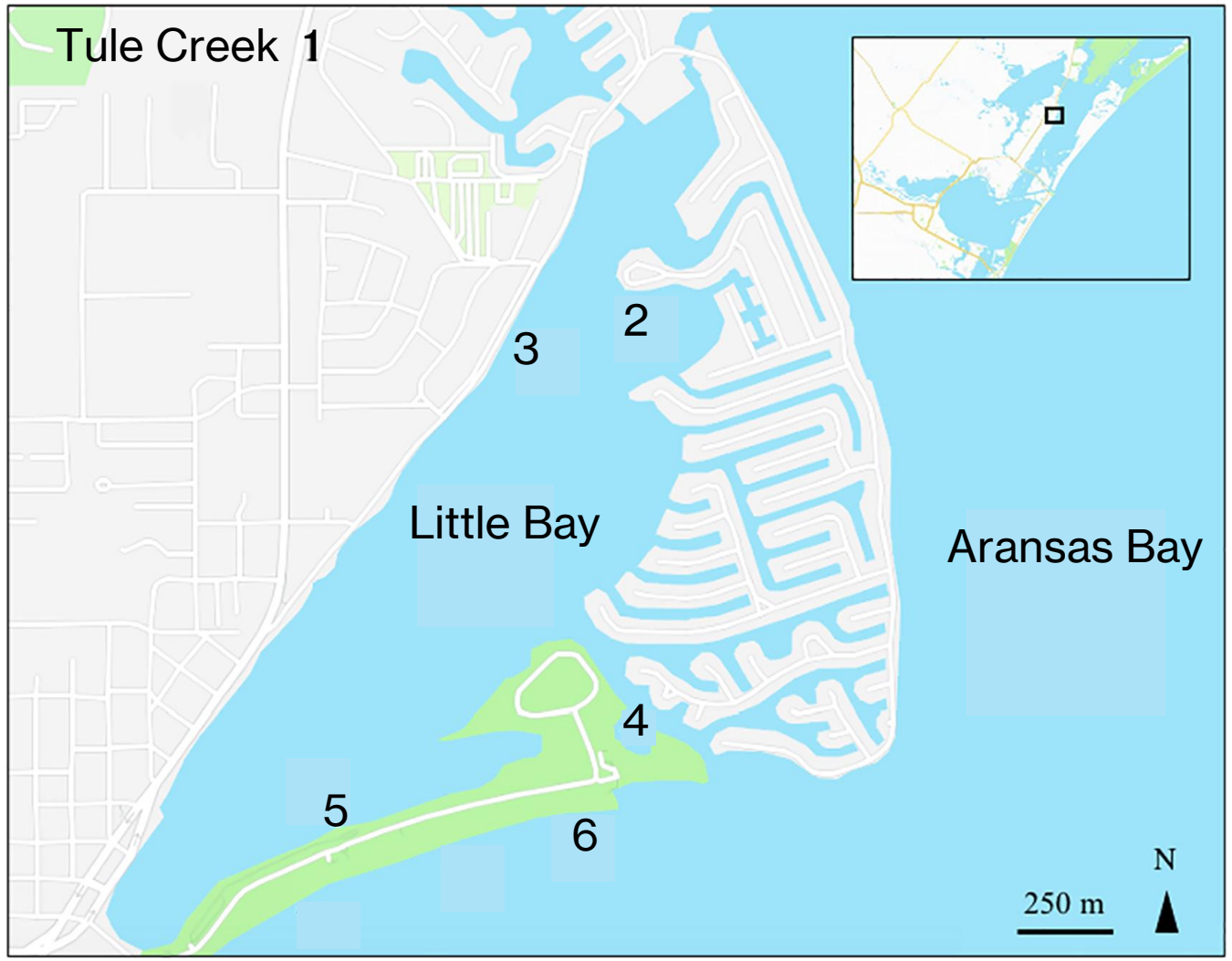
Tule Creek

vs.

Little Bay

vs.

Aransas Bay

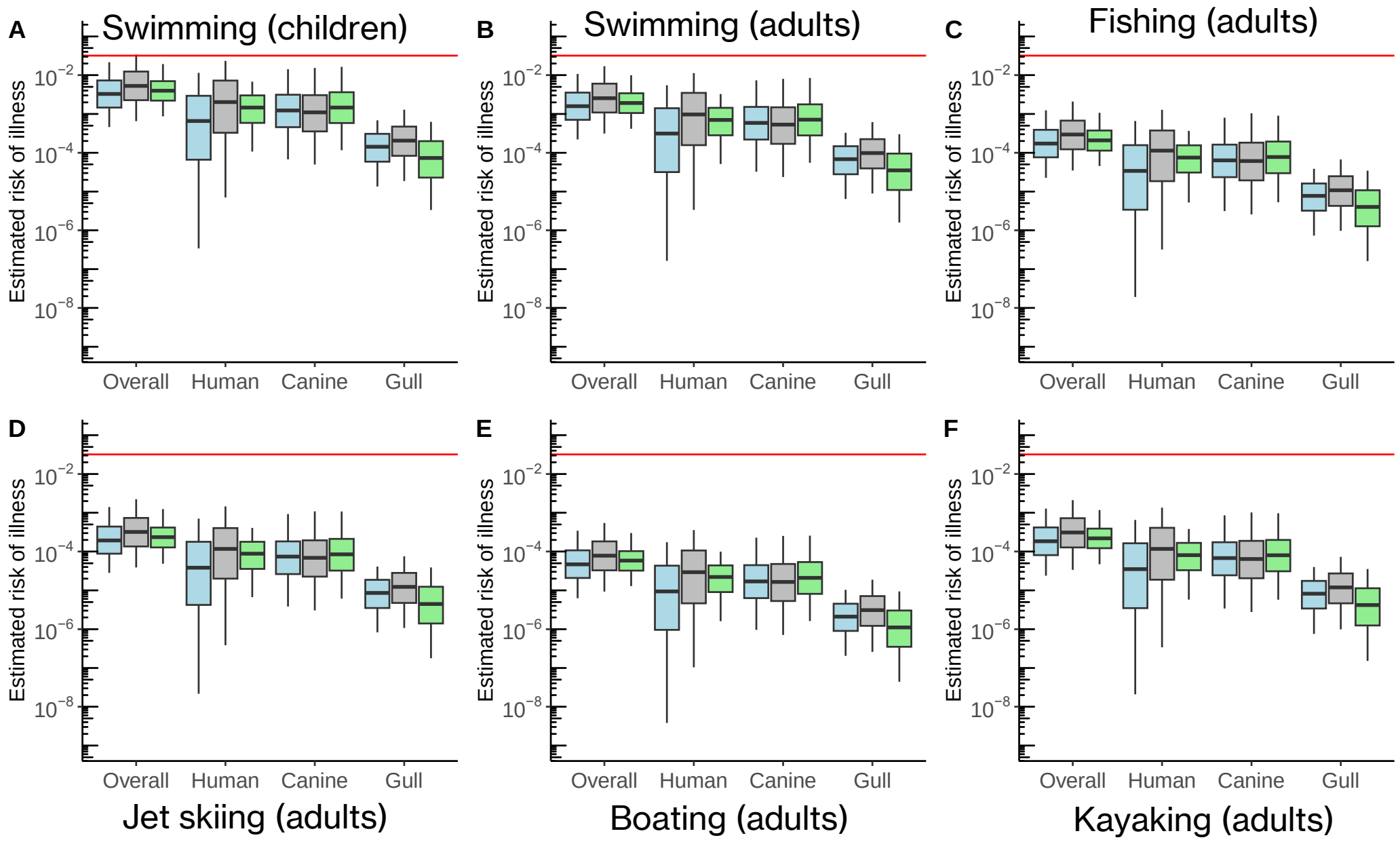


Red line = 32 illnesses per 1,000 people

Location Tule Creek Little Bay Aransas Bay

Red line = 32 illnesses per 1,000 people

Location: Tule Creek, Little Bay, Aransas Bay



Risk Assessment:

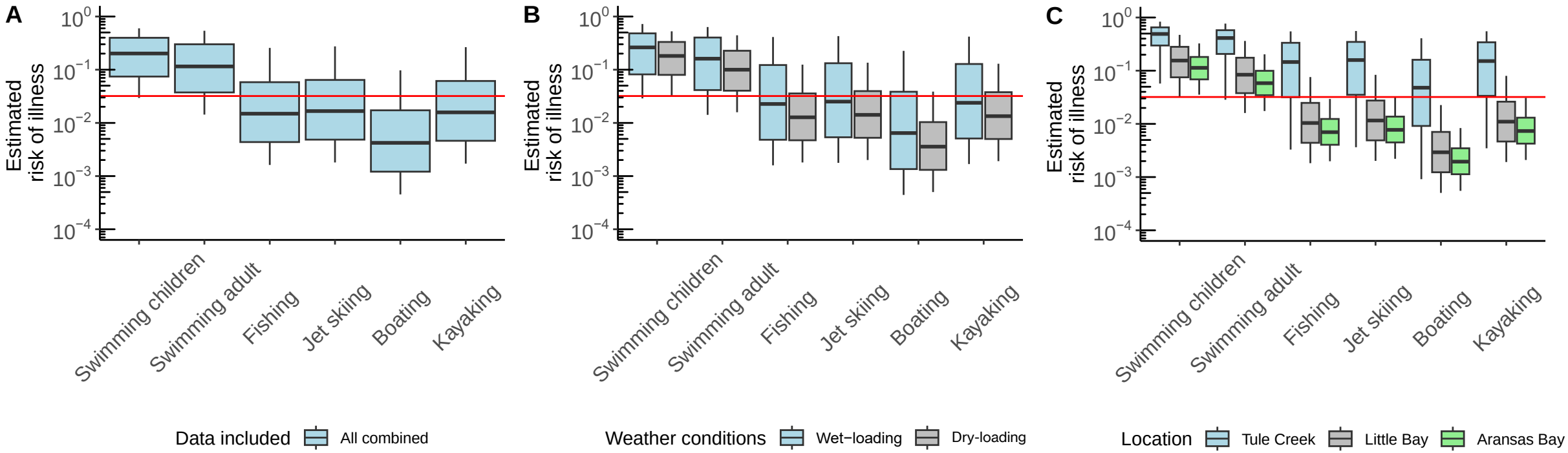
Enterococci Data

- Not host-specific
- Not always correlated with pathogens
- Assuming 5% from human fecal source
- Raw sewage, not effluent

(IDEXX)

Human Health Risks Based on Enterococci Data (assuming 5% from human fecal source)

Human Health Risks Based on Enterococci Data (assuming 5% from human fecal source)



What does this mean?

- Health risks estimated using MST data do not indicate that there is an increased risk for public health.
- Human fecal source inputs are of greatest risk for human health, followed by the canine fecal source.
- When comparing enterococci data and MST data, the MST data provides a much more realistic representation of fecal sources and associated risks for public health.
- Fishing, kayaking, jet skiing, and boating have relatively low risks for illness compared to swimming.

Next Steps

- Disseminating findings
  - Continue meeting with stakeholders
  - Publish research to help inform policy
- Apply MST/QMRA framework in other coastal communities
  - Baffin Bay
  - City-By-The-Sea
- Seek additional grant funding to continue addressing water quality impairments and concerns in Little Bay

Funding & Acknowledgements

FUNDING

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The bacterial source tracking project was conducted thanks to the funding and support from the Aransas County Navigation District, the Coastal Bend Bays and Estuaries Program (CBBEP), Dr. Jeffrey Turner (TAMU-CC), and the citizens of Rockport, Texas.

Contact

Anna Gitter	Anna.Gitter@uth.tmc.edu
Nicole Powers	Nicole.Powers@tamucc.edu
Shay Postma	Shaylynn.Postma@ag.tamu.edu
Lucas Gregory	Lucas.Gregory@ag.tamu.edu

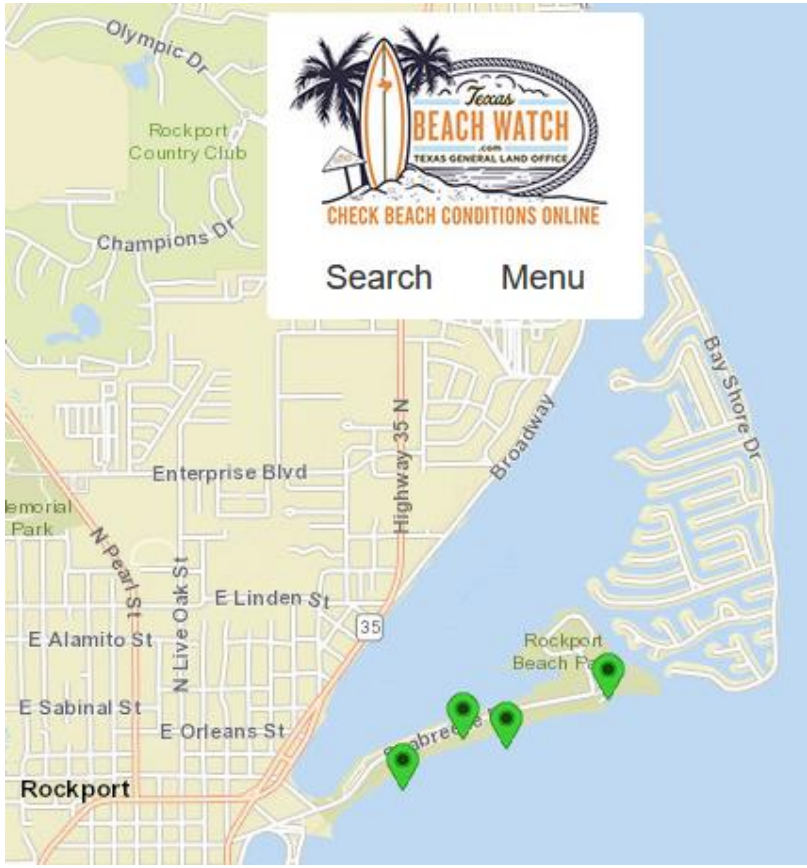
Water Quality Background

(Photo: CBBEP)

Why Are We Here?

- Texas Beach Watch data show a history of high enterococci concentrations in 2 Little Bay sampling stations

- Source of bacteria unknown -
  - Local concerns over high concentrations of bacteria in Tule Creek
    - Receiving water of treated wastewater effluent
  - Potential influence from pets and wildlife – especially gulls



Clean Water Act

- Restore and maintain the chemical, physical, and biological integrity of the Nation's waters
- Sets the basic framework for regulating discharges of pollutants into waters of the U.S. and regulating water quality standards for surface waters

Beach Act

- Amendment to Clean Water Act
- Requires water quality standards for marine recreational waters
  - Specifically for pathogens
- Develop and implement monitoring plans for marine waters

Surface Water Quality Standards

Texas Standards

Designated Use	Criteria	Parameter
Primary Contact Recreation	126 MPN/100 mL (FW) 35 MPN/100 mL (Marine)	*E. coli* Bacteria (FW) Enterococci (Marine)
Secondary Contact Recreation 1	630 MPN/100 mL (FW) 175 MPN/100 mL (Marine)	*E. coli* Bacteria (FW) Enterococci (Marine)
High Aquatic Life Use	5.0 mg/L Average 3.0 mg/L Minimum	Dissolved Oxygen
General Use	6.5 – 9.0	pH

Texas' Recreation Definitions

PCR 1 - Activities that are presumed to involve a significant risk of ingestion of water (e.g., wading by children, swimming, skiing, handfishing, and whitewater activities)

PCR 2 – Same as PCR 1 but less frequently due to physical water body characteristics or limited access

SCR 1 - Activities that commonly occur with limited body contact incidental to shoreline activity (e.g., wading by adults, fishing, canoeing, rafting boating). Presumed to pose less significant water ingestion risk than PCR 1 or 2, but more than SCR 2.

SCR 2 - Activities with limited body contact incidental to shoreline activity (e.g. fishing, kayaking, boating) presumed to pose a less significant water ingestion risk than SCR 1 and occur less often than SCR 1 due to physical characteristics and limited access.

Previous Project

Previous Project

ACS ES&T Water

Publication Date: May 2021

pubs.acs.org/estwater Article

Water Quality Dynamics in Response to Rainfall along an Estuarine Ecocline

Nicole C. Powers, Lee J. Pinnell, Hailey R. Wallgren, Sandra Marbach, and Jeffrey W. Turner*

Cite This: https://doi.org/10.1021/acsestwater.1c00051 Read Online

Bacteria levels after wet-loading vs. dry-loading

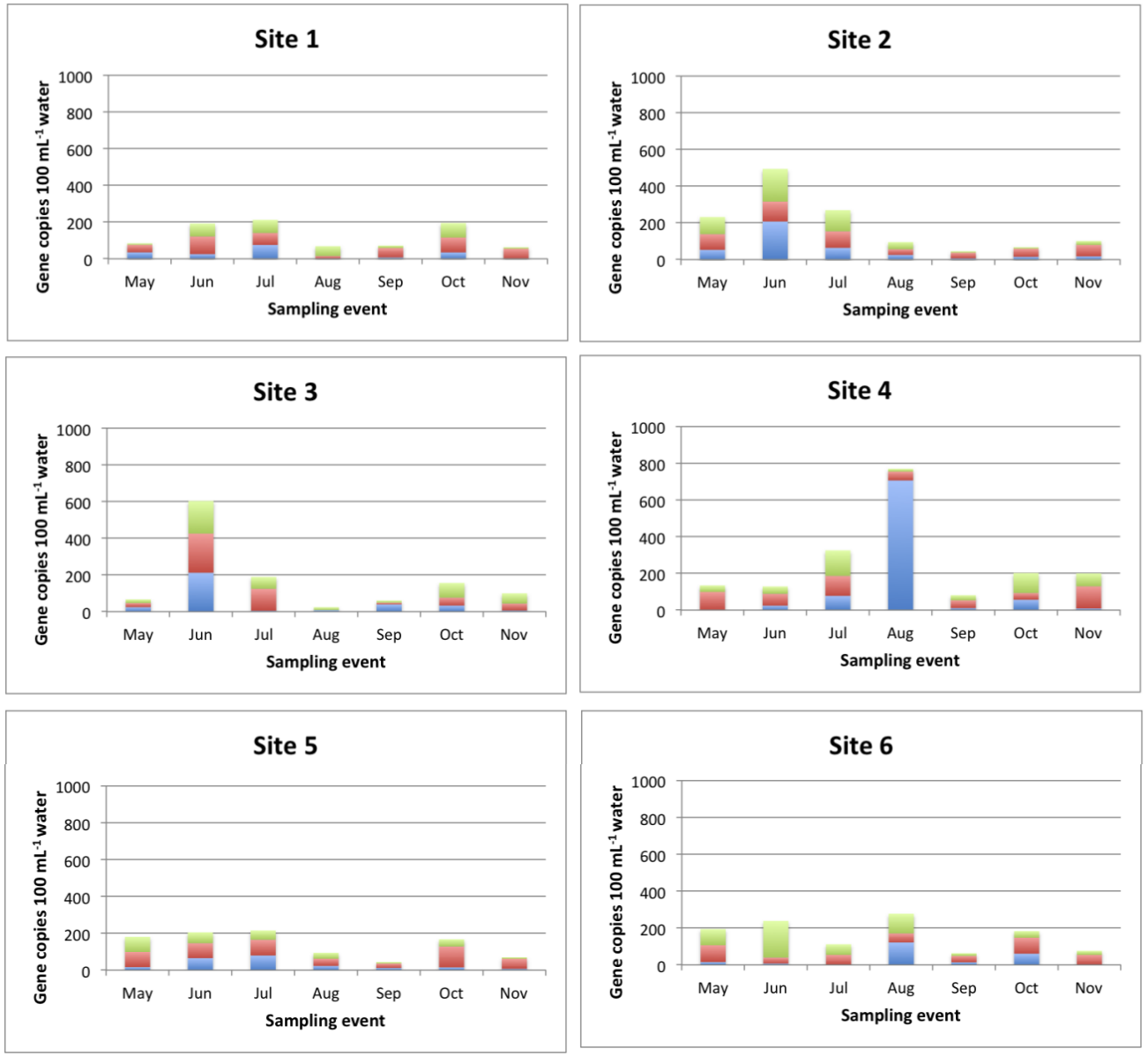
Event type	Bacterial target	Min	Max	Geo mean	Med
Wet-loading	Enterococci	<10.00	24,196.00	76.57	30.50
	[a]Human marker	0.00	77.78	33.51[b]	37.78
	Canine marker	33.34	120.00	69.57	77.23
	Gull marker	7.78	138.89	50.55	67.79
Dry-loading	Enterococci	<10.00	1,399.00	38.33	20.5
	[a]Human marker	0.00	736.67	21.21[b]	16.11
	Canine marker	0.00	213.34	15.55[b]	49.45
	Gull marker	7.78	198.89	31.49	31.67

(Powers et al., 2020)

Bacteria levels in Tule Creek, Little Bay, and Aransas Bay

Location	Bacterial target	Min	Max	Geo mean	Med
Tule Creek (WWTP catchment)	[a]Enterococci	114.50	24,196.00	642.88	373.00
	Human marker	0.00	75.56	21.46[b]	25.56
	Canine marker	15.56	96.67	52.12	55.56
	Gull marker	7.78	78.89	28.92	53.34
Little Bay	[a]Enterococci	<10.00	557.00	31.71	23.00
	Human marker	0.00	736.67	26.81[b]	24.45
	Canine marker	0.00	213.34	57.44[b]	54.45
	Gull marker	7.78	198.89	43.06	43.33
Aransas Bay	[a]Enterococci	<10.00	25.50	13.01	<10
	Human marker	7.78	76.67	18.81	16.11
	Canine marker	24.45	113.34	55.22	54.45
	Gull marker	7.78	82.23	22.05	16.67

(Powers et al., 2020)



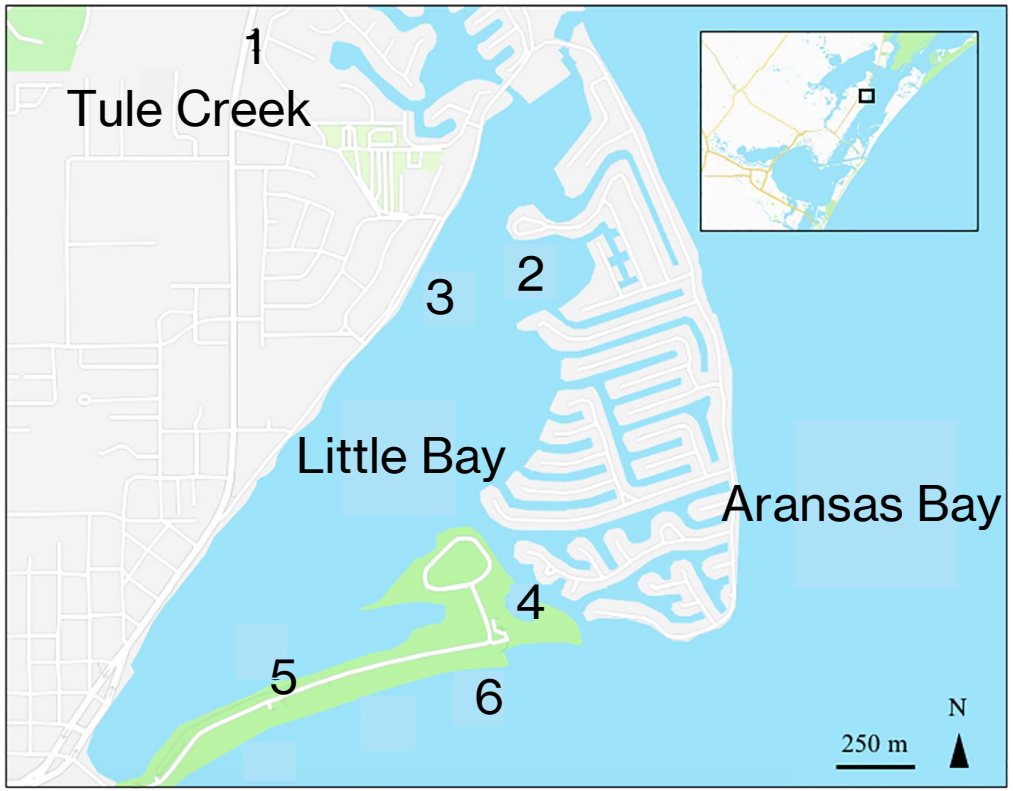
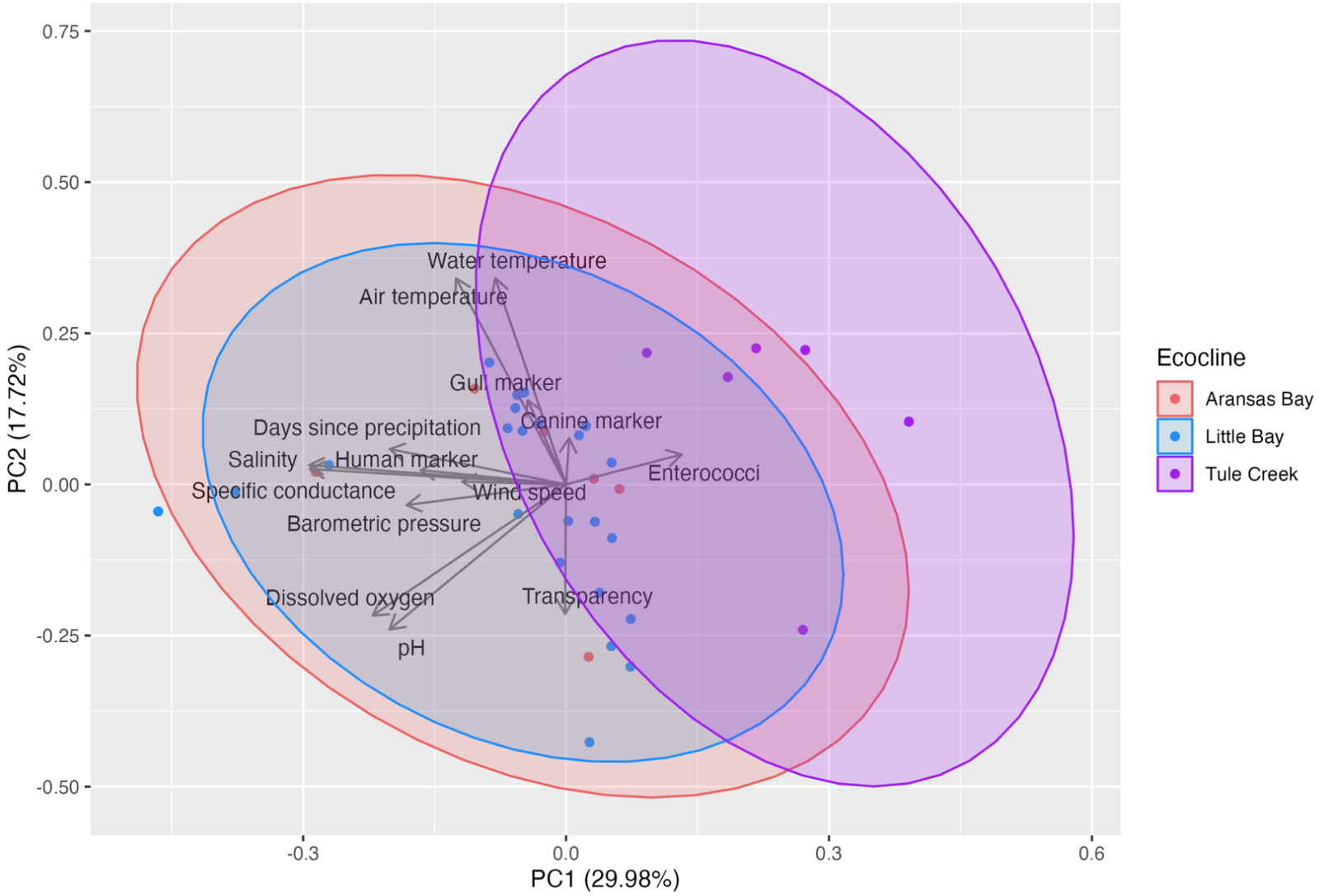


Figure 4 (CBBEP-127). Average abundance (gene copies per 100mL water) of human (blue), canine (red), and gull (green) markers.

Environmental Data



Estimated Health Risks

Activity	Fecal source	Median risk of illness (all data)	Median risk of illness (wet-loading)	Median risk of illness (dry-loading)	Median risk of illness (Tule Creek)	Median risk of illness (Little Bay)	Median risk of illness (Aransas Bay)
Swimming (children)	Overall*	4.10×10^{-3}	6.23×10^{-3}	4.42×10^{-3}	3.29×10^{-3}	5.29×10^{-3}	3.98 X 10-3
	Human	1.20×10^{-3}	3.59×10^{-3}	1.54×10^{-3}	6.56×10^{-4}	2.03×10^{-3}	1.47×10^{-3}
	Canine	1.20×10^{-3}	1.63×10^{-3}	1.00×10^{-3}	1.23×10^{-3}	1.10×10^{-3}	1.47×10^{-3}
	Gull	1.80×10^{-4}	2.15×10^{-4}	2.31×10^{-4}	1.43×10^{-4}	2.06×10^{-4}	7.33×10^{-5}
	Enterococci	2.01×10^{-1}	2.62×10^{-1}	1.81×10^{-1}	4.91×10^{-1}	1.55×10^{-1}	1.13×10^{-1}
Swimming (adult)	Overall*	2.00×10^{-3}	3.00×10^{-3}	2.13×10^{-3}	1.59×10^{-3}	2.55×10^{-3}	1.92×10^{-3}
	Human	5.60×10^{-4}	1.72×10^{-3}	7.36×10^{-4}	3.13×10^{-4}	9.70×10^{-4}	7.03×10^{-4}
	Canine	5.60×10^{-4}	7.85×10^{-4}	4.83×10^{-4}	5.89×10^{-4}	5.31×10^{-4}	7.10×10^{-4}
	Gull	8.60×10^{-5}	1.02×10^{-4}	1.10×10^{-4}	6.82×10^{-5}	9.85×10^{-5}	3.50×10^{-5}
	Enterococci	1.15×10^{-1}	1.61×10^{-1}	1.00×10^{-1}	4.12×10^{-1}	8.42×10^{-2}	5.83×10^{-2}
Fishing	Overall*	2.27×10^{-4}	3.40×10^{-4}	2.36×10^{-4}	1.73×10^{-4}	2.95×10^{-4}	2.09×10^{-4}
	Human	6.28×10^{-5}	1.93×10^{-4}	7.83×10^{-5}	3.41×10^{-5}	1.13×10^{-4}	7.49×10^{-5}
	Canine	6.33×10^{-5}	8.89×10^{-5}	5.38×10^{-5}	6.36×10^{-5}	6.14×10^{-5}	7.75×10^{-5}
	Gull	9.73×10^{-6}	1.12×10^{-5}	1.27×10^{-5}	7.73×10^{-6}	1.08×10^{-5}	4.02×10^{-6}
	Enterococci	1.49×10^{-2}	2.27×10^{-2}	1.27×10^{-2}	1.46×10^{-1}	1.04×10^{-2}	6.98×10^{-3}
Jet skiing	Overall*	2.48×10^{-4}	3.79×10^{-4}	2.66×10^{-4}	1.93×10^{-4}	3.20×10^{-4}	2.35×10^{-4}
	Human	6.60×10^{-5}	2.11×10^{-4}	9.08×10^{-5}	3.86×10^{-5}	1.17×10^{-4}	8.81×10^{-5}
	Canine	7.00×10^{-5}	9.94×10^{-5}	5.91×10^{-5}	7.40×10^{-5}	6.89×10^{-5}	8.50×10^{-5}
	Gull	1.04×10^{-5}	1.33×10^{-5}	1.37×10^{-5}	8.58×10^{-6}	1.23×10^{-5}	4.46×10^{-6}
	Enterococci	1.66×10^{-2}	2.51×10^{-2}	1.41×10^{-2}	1.59×10^{-1}	1.16×10^{-2}	7.74×10^{-3}
Boating	Overall*	6.30×10^{-5}	9.51×10^{-5}	6.68×10^{-5}	4.70×10^{-5}	7.87×10^{-5}	5.83×10^{-5}
	Human	1.69×10^{-5}	5.27×10^{-5}	2.31×10^{-5}	9.35×10^{-6}	2.93×10^{-5}	2.20×10^{-5}
	Canine	1.78×10^{-5}	2.53×10^{-5}	1.52×10^{-5}	1.70×10^{-5}	1.65×10^{-5}	2.11×10^{-5}
	Gull	2.67×10^{-6}	3.15×10^{-6}	3.53×10^{-6}	2.10×10^{-6}	3.11×10^{-6}	1.11×10^{-6}
	Enterococci	4.20×10^{-3}	6.45×10^{-3}	3.58×10^{-3}	4.80×10^{-2}	2.92×10^{-3}	1.95×10^{-3}
Kayaking	Overall*	2.32×10^{-4}	3.52×10^{-4}	2.48×10^{-4}	1.84×10^{-4}	3.12×10^{-4}	2.20×10^{-4}
	Human	6.40×10^{-5}	1.98×10^{-4}	8.10×10^{-5}	3.53×10^{-5}	1.17×10^{-4}	8.11×10^{-5}
	Canine	6.56×10^{-5}	9.18×10^{-5}	5.59×10^{-5}	6.78×10^{-5}	6.41×10^{-5}	8.00×10^{-5}
	Gull	1.03×10^{-5}	1.23×10^{-5}	1.34×10^{-5}	8.23×10^{-6}	1.19×10^{-5}	4.17×10^{-6}
	Enterococci	1.57×10^{-2}	2.39×10^{-2}	1.34×10^{-2}	1.52×10^{-1}	1.10×10^{-2}	7.36×10^{-3}