

# **Estuary Sediment and Suspended Solids Bacteria: Implications for Microbial Pollution Sources and Monitoring**



**David Lewis, Edward R. Atwill,  
Maria D. G. Pereira, Ronald F. Bond, Miguel Huerta**

**USDA-CSREES National Water Conference 2008**



# **WARNING**

**Avoid contact  
with water**

Bacterial testing shows that  
water **DOES NOT** meet  
State standards for  
recreational contact.

For information call  
Marin County Environmental  
Health Services Beach Hotline  
at 415-473-2335  
or [www.earth911.org](http://www.earth911.org).





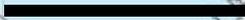
# Generating valid monitoring data for bacterial indicators

## Fresh to saltwater transition zone: delta/estuary

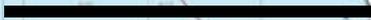
### ■ Challenges

- tidal influences at monitoring sites
- limited access for monitoring sites: sampling at bridges (upstream), nearshore, shallow (tss higher)
- resuspension of estuarine sediments

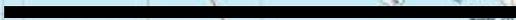
**Russian**



**Salmon**



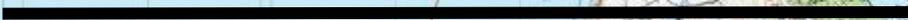
**Americano**



**Walker**



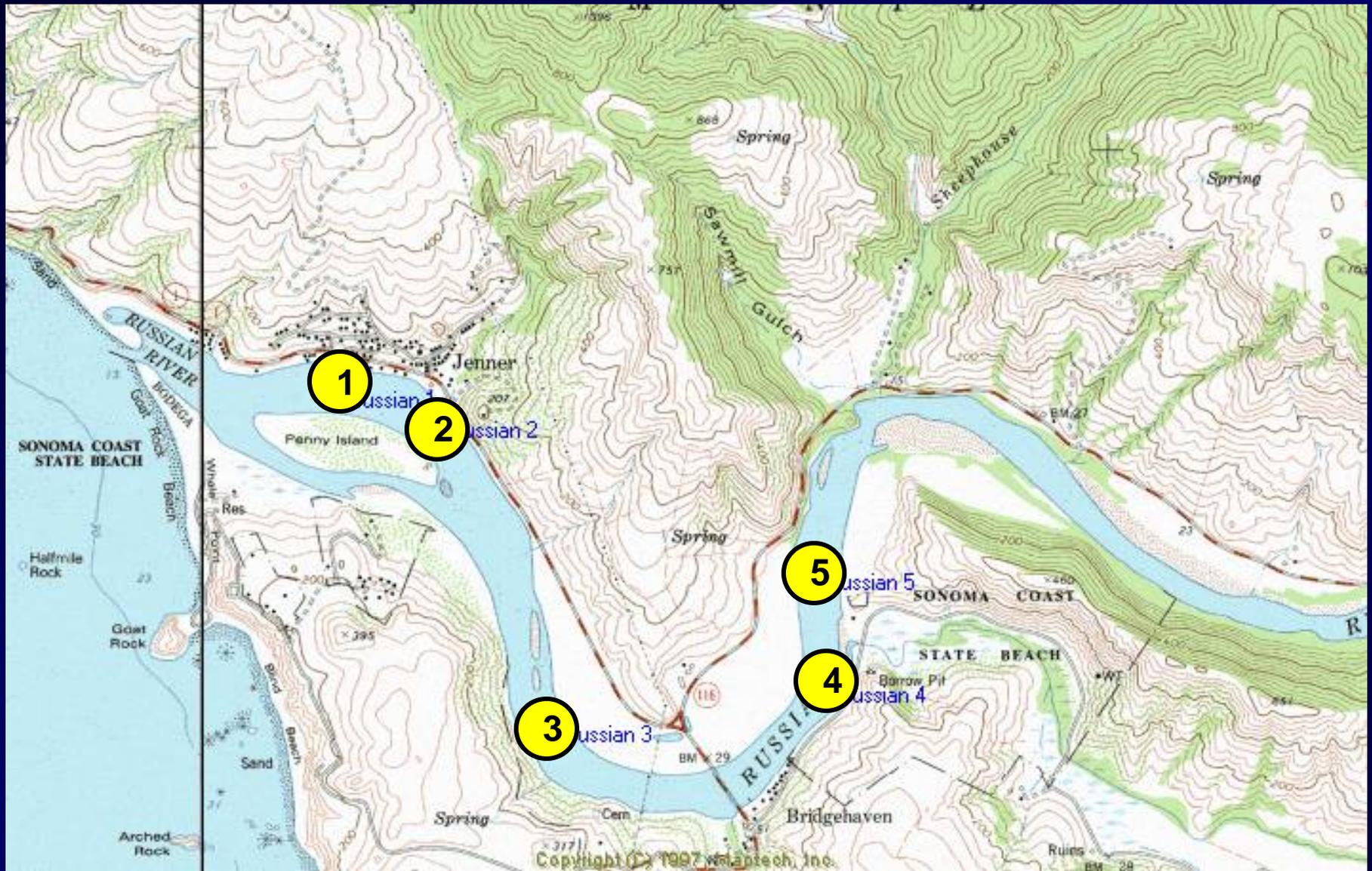
**Lagunitas**





Photograph courtesy of Gold Ridge RCD.





flow

middle  
● ● ●  
right left

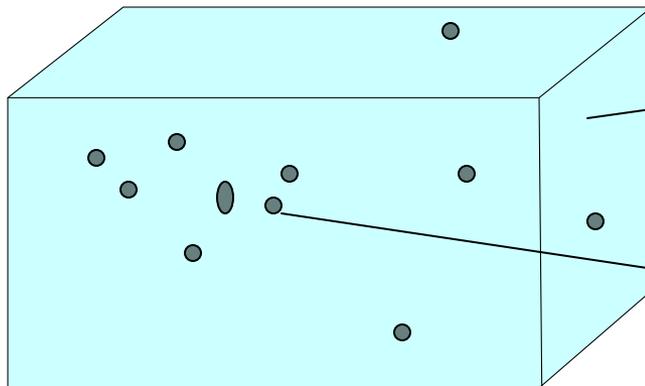
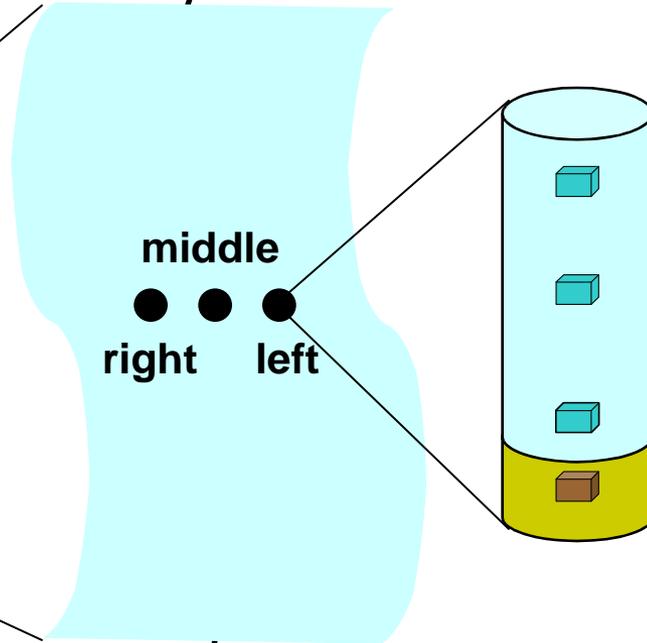
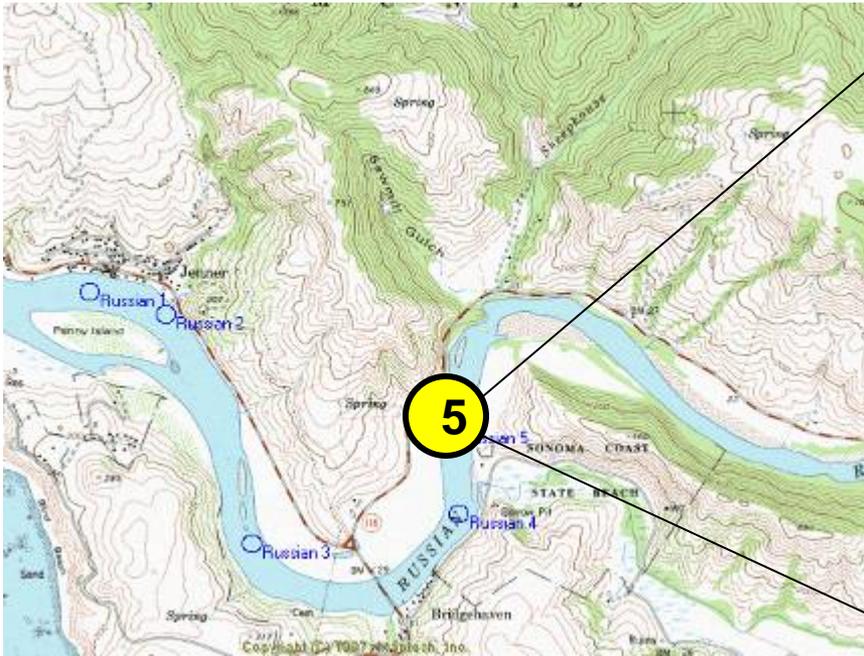
three water  
samples

one sediment  
sample

5

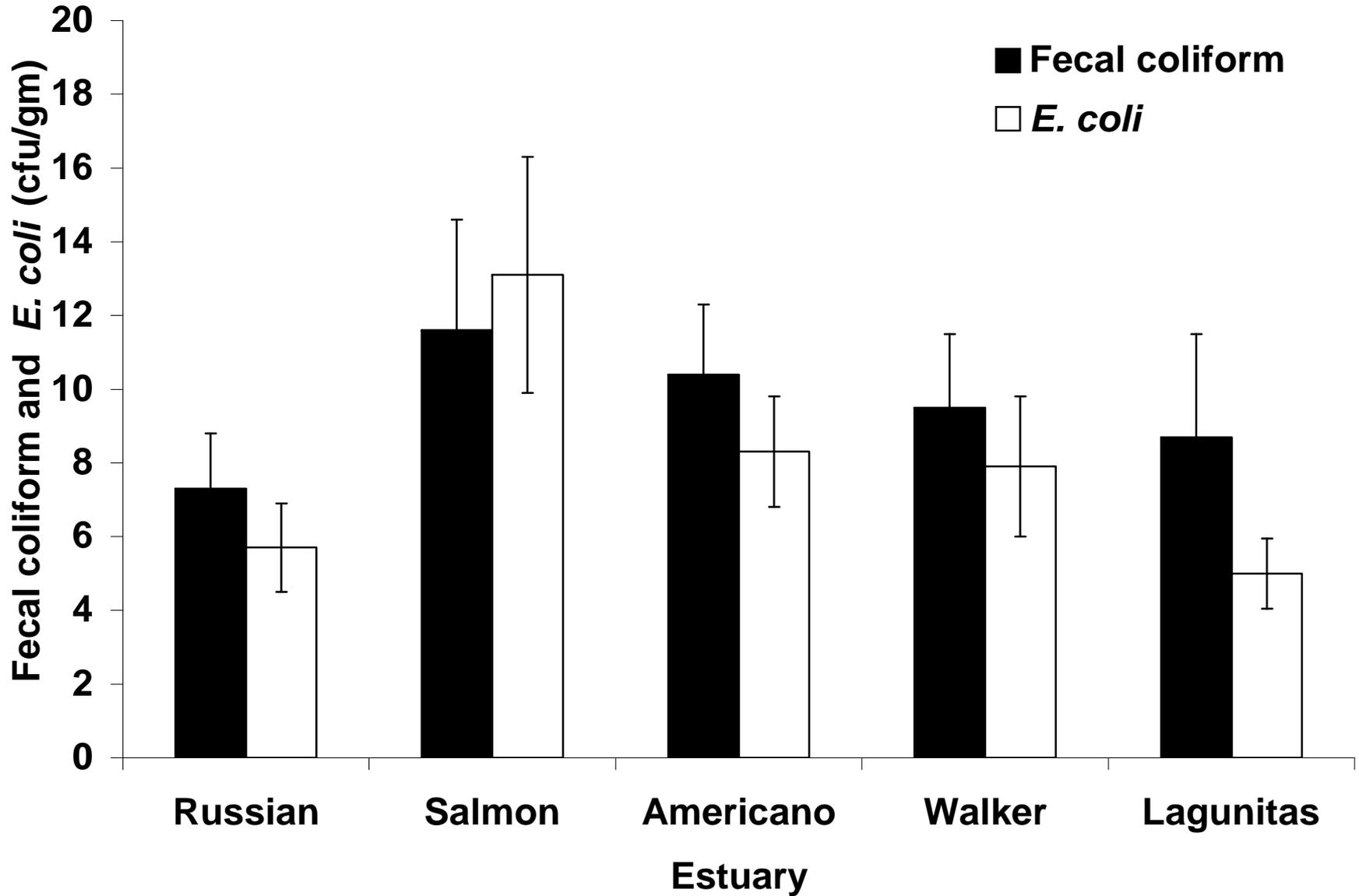
Water Fraction

Total Suspended Solids Fraction

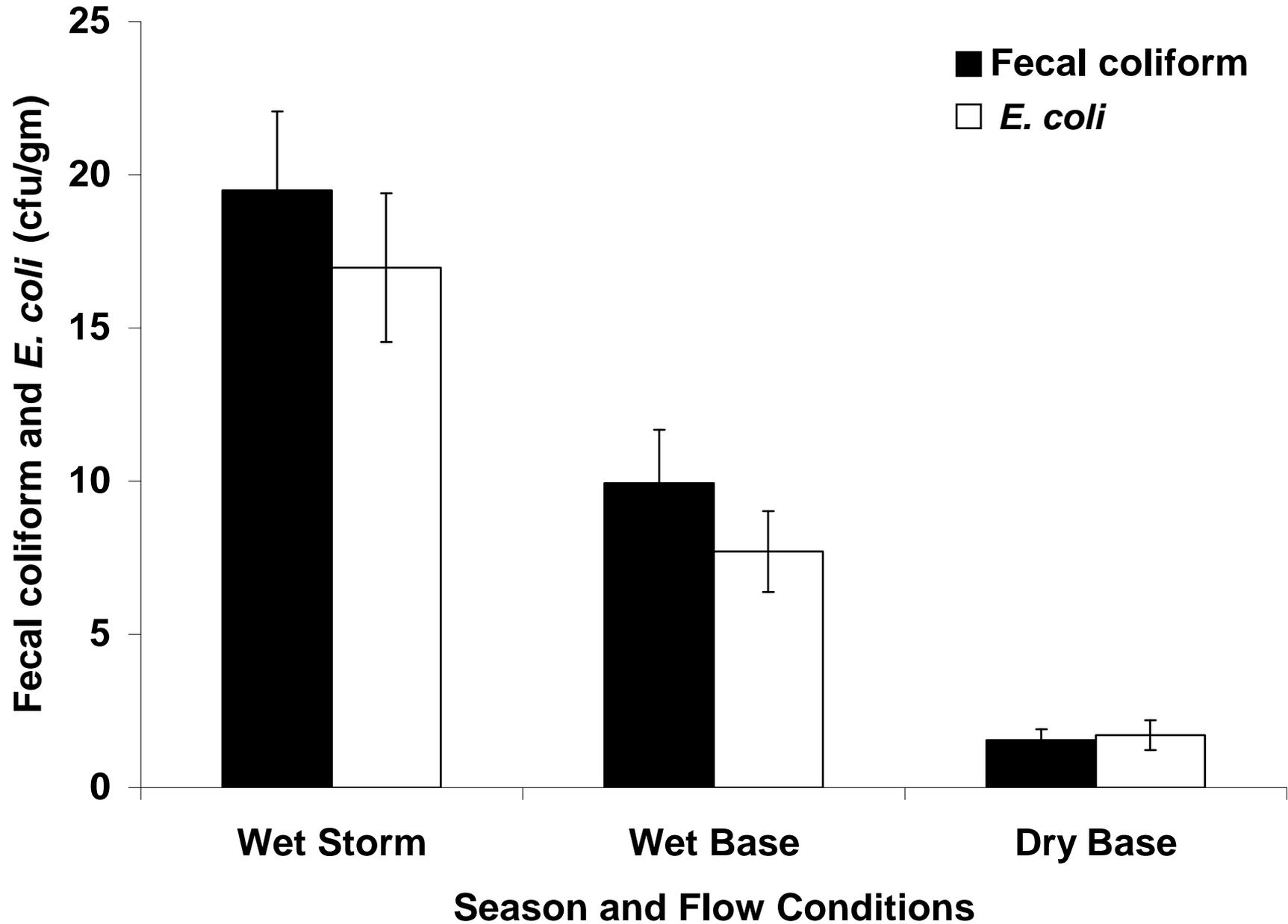




# Bacteria concentrations by estuary



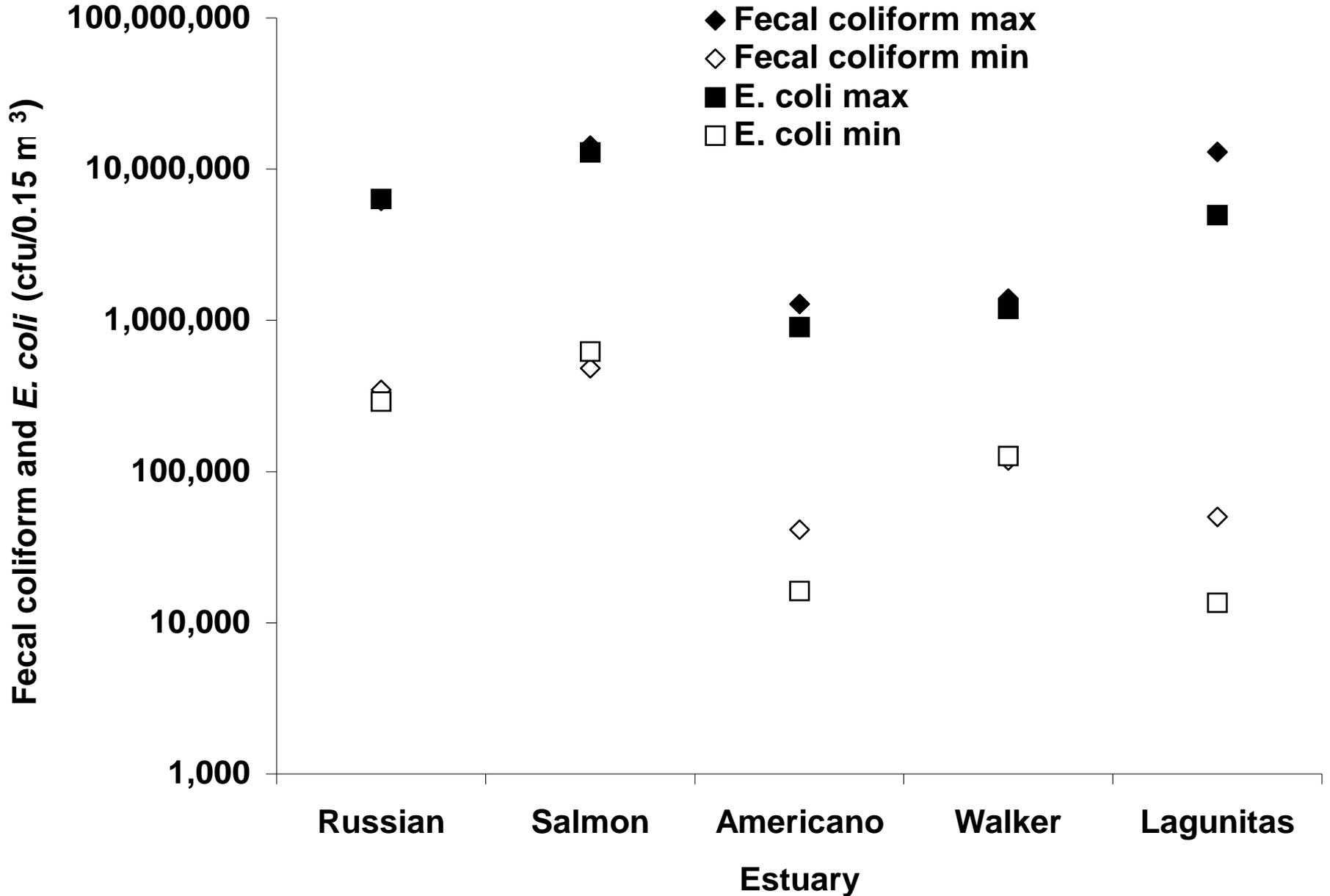
# Season and Flow Conditions





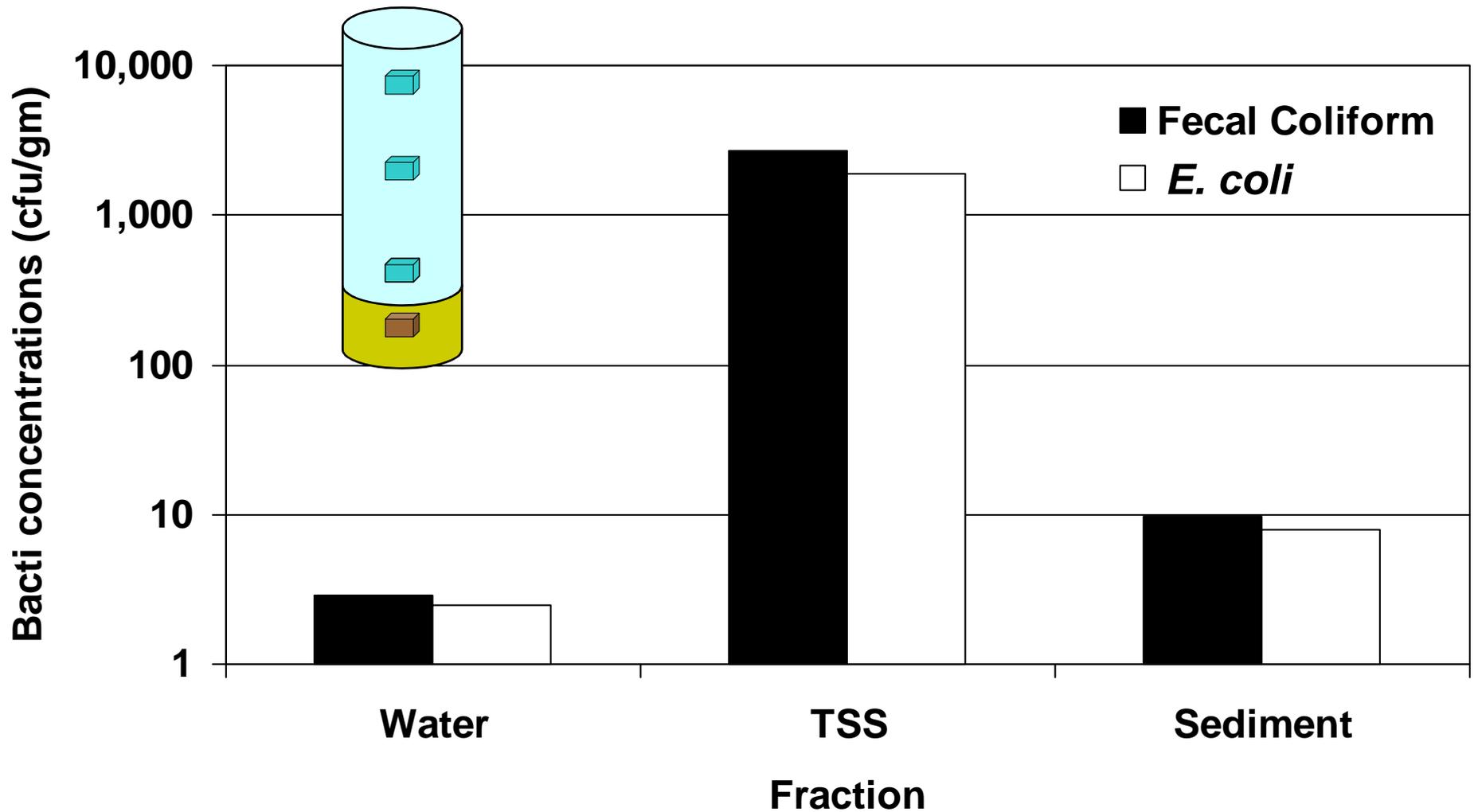
Photograph courtesy of Gold Ridge RCD.

# Total bacteria per square meter of estuary sediment

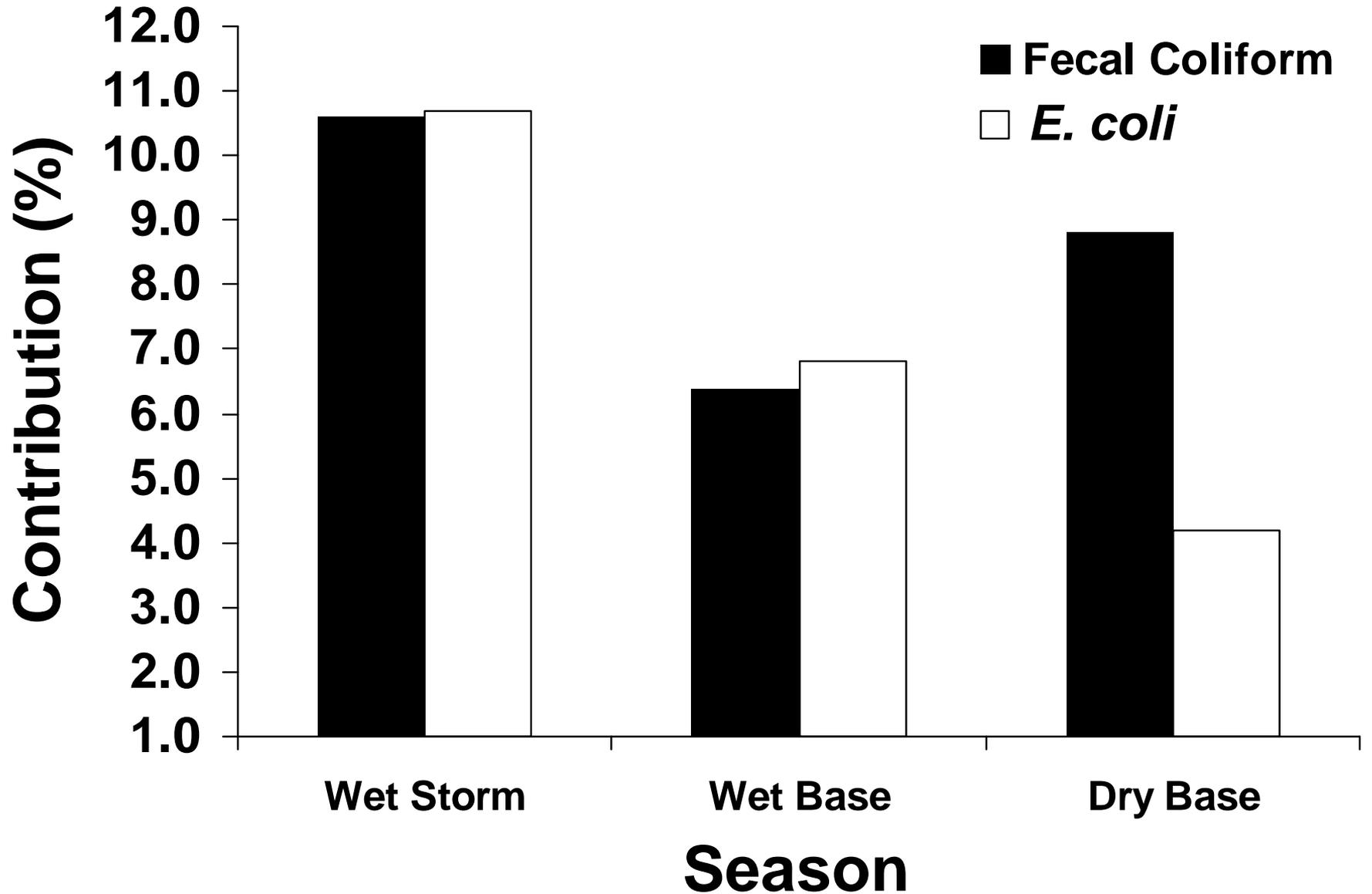




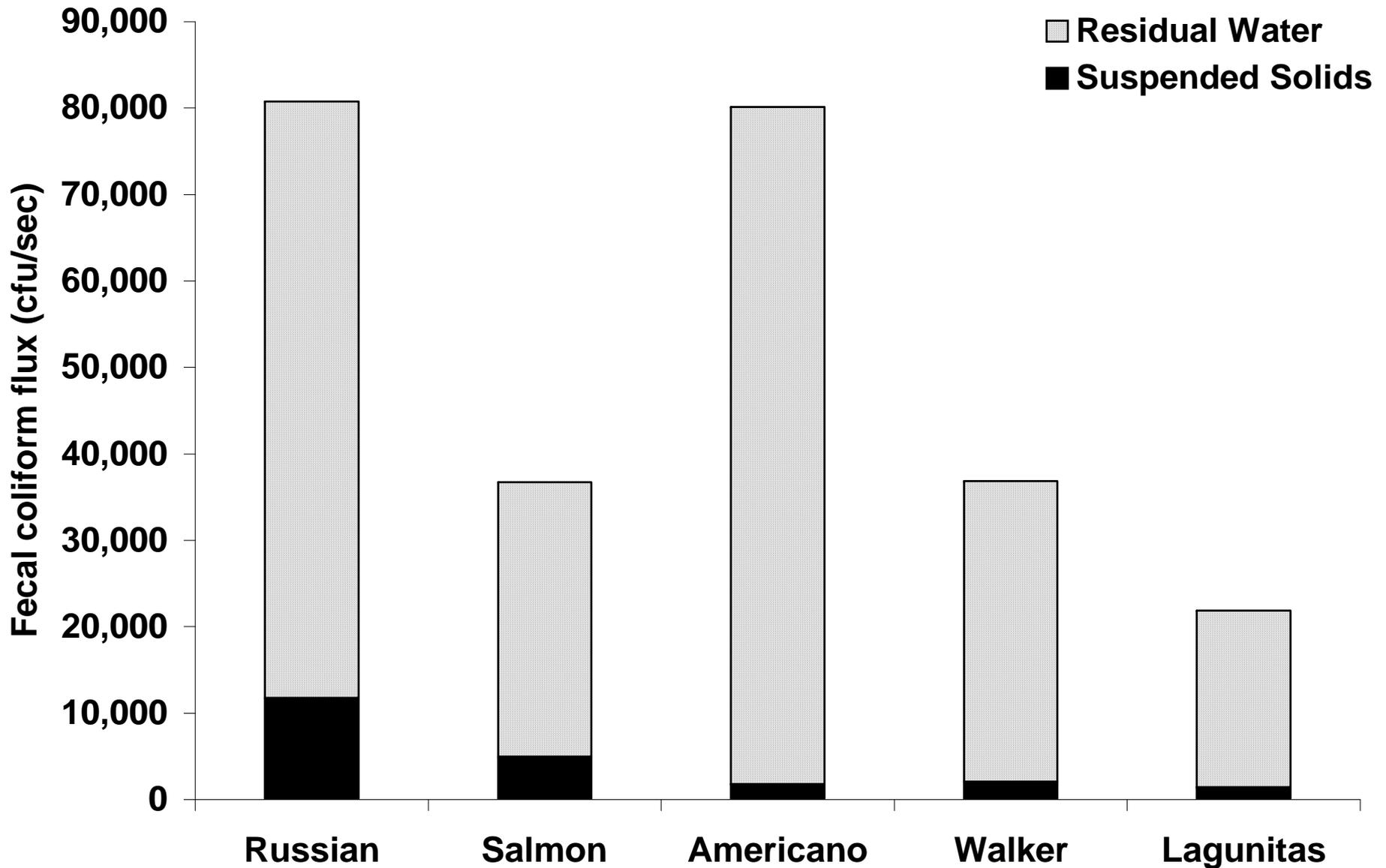
# Standardized mean fecal coliform and *E. coli* concentration for each fraction



# TSS contribution of bacteria to whole water sample



# Mean total flux

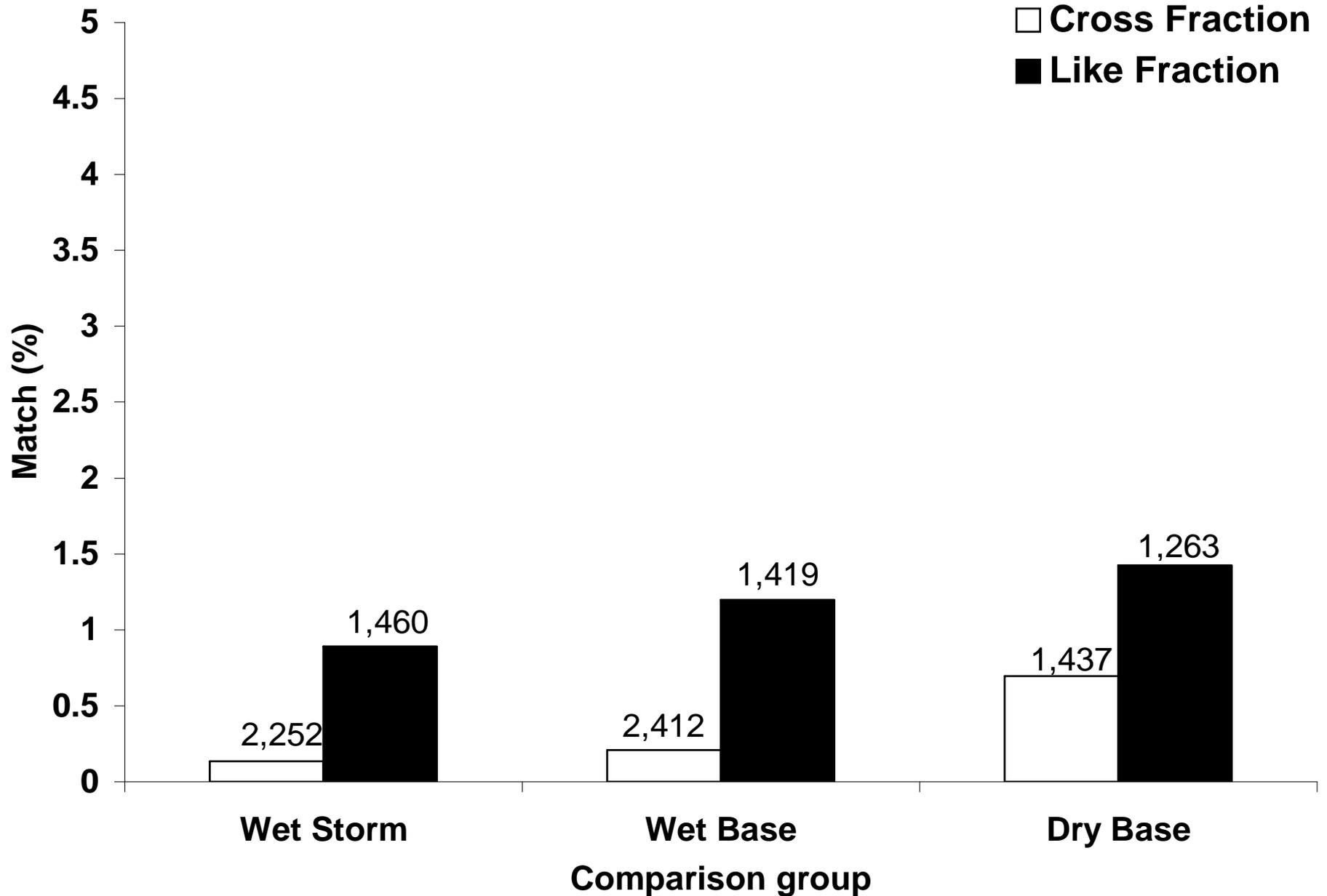


# Box-PCR

- Rep-PCR genomic fingerprinting
- Selective amplification of distinct genomic regions located between highly conserved regions



# Inter- and Intra-fraction percent match



# Conclusions

- Estuary sediment is a reservoir for significant quantities of indicator bacteria.
- Total Suspended Solids has the highest bacteria concentration relative to residual water and estuary sediment on a standardized basis.
- Total Suspended Solids derived bacteria constitutes 4 to 11% of the bacteria concentrations in a water sample and 3 to 14% of the total instantaneous flux in the studied estuaries.
- Percent genetic match across the three studied fractions (water, TSS, sediment) is:
  - Less than 3%
  - Highest in dry baseflow followed by wet baseflow followed by wet stormflow
  - Highest in like fraction comparison than cross fraction comparison
- Freshwater flows during winter storms contribute to elevated water column and estuary sediment bacteria values.

(Supported by the California State Water Resources Control Board and North Coast Region Water Quality Control Board through the Costa-Machado Act of 2002)