

Evaluation of Coliphage as a Beach Water Quality Indicator

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Presentation to the SCCWRP Commission

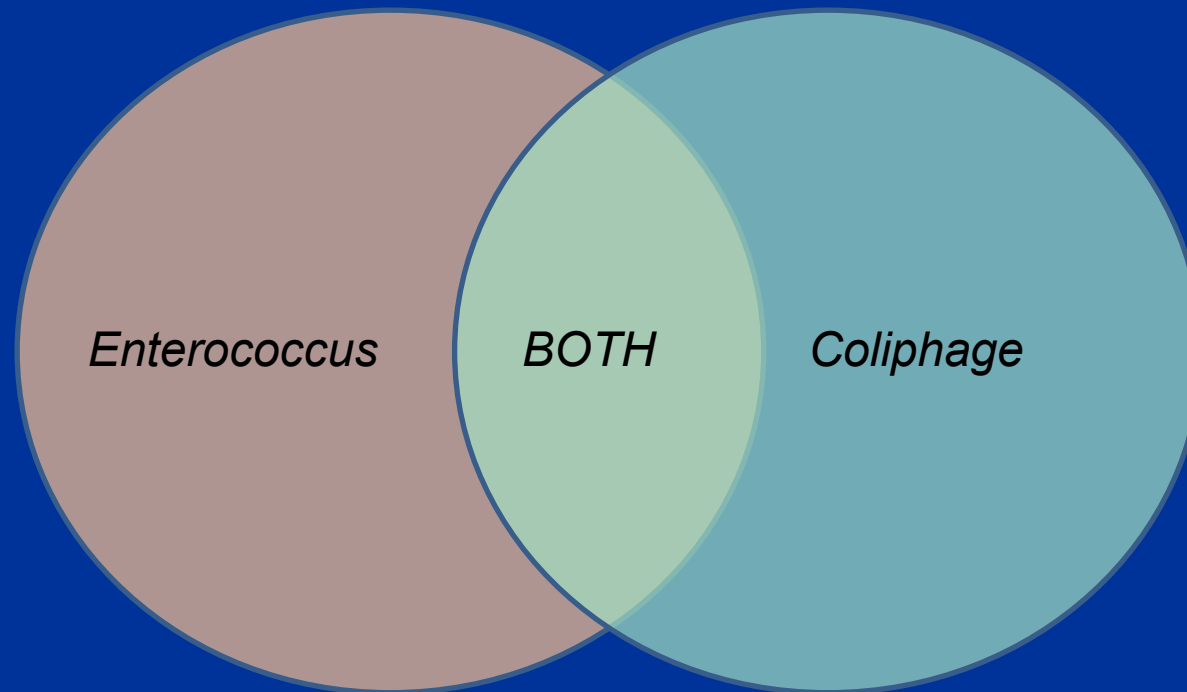
March 4, 2022

COLIPHAGE - CURRENT STATUS

- **EPA has been developing coliphage as a viral water quality indicator for the past 7 years**
 - 2015 - Published a review of coliphages as possible viral indicators of fecal contamination
 - 2016 - Coliphages a focus at EPA Recreational Water Conference
 - 2018 - EPA published Method 1642 for Enumeration of Coliphage in Recreational Waters
- **Two major types: Somatic and Male-specific (F+)**
 - Both are viruses that infect *E. coli* and related coliform bacteria (not human pathogens)
 - Present in high numbers in human feces
- **Why measure coliphages?**
 - Viruses are the cause of most swimming-associated illnesses in human-impacted waters
 - Mimic human viruses in WWTP's and in the environment
 - Easy to measure and already approved for groundwater and shellfish monitoring

BIGHT 18' MICROBIOLOGY COMMITTEE GOALS

- Determine “ease of use” of the new coliphage method
- Determine relationship between coliphage and Enterococcus at local beaches



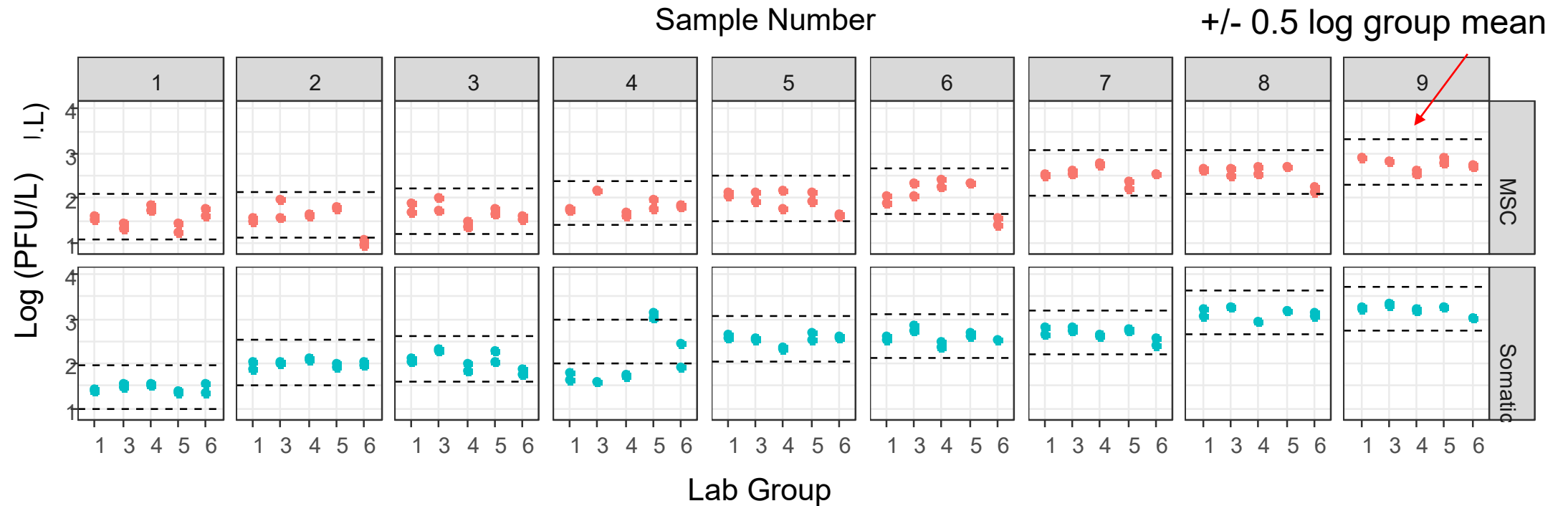
APPROACH

- **Train labs in Method 1642 and conduct intercalibration study**
- **Conduct beach water testing**
 - Initiated August 2019

PARTICIPATING LABS

- **Orange County Sanitation District**
- **Orange County Public Health Lab**
- **City of Los Angeles**
- **Los Angeles County Sanitation District**
- **City of San Diego**
- **County of Ventura (Cal State Channel Islands)**

MEASURED COLIPHAGE LEVELS FROM SPIKED WATER SAMPLES



RESULTS OF LAB INTERCALIBRATION

- All labs were able to meet EPA Method Validation Criteria
- Produced repeatable results both within and across labs
- Manuscript describing study accepted to *Journal of Applied Microbiology*

BIGHT 18' MICROBIOLOGY COMMITTEE GOALS

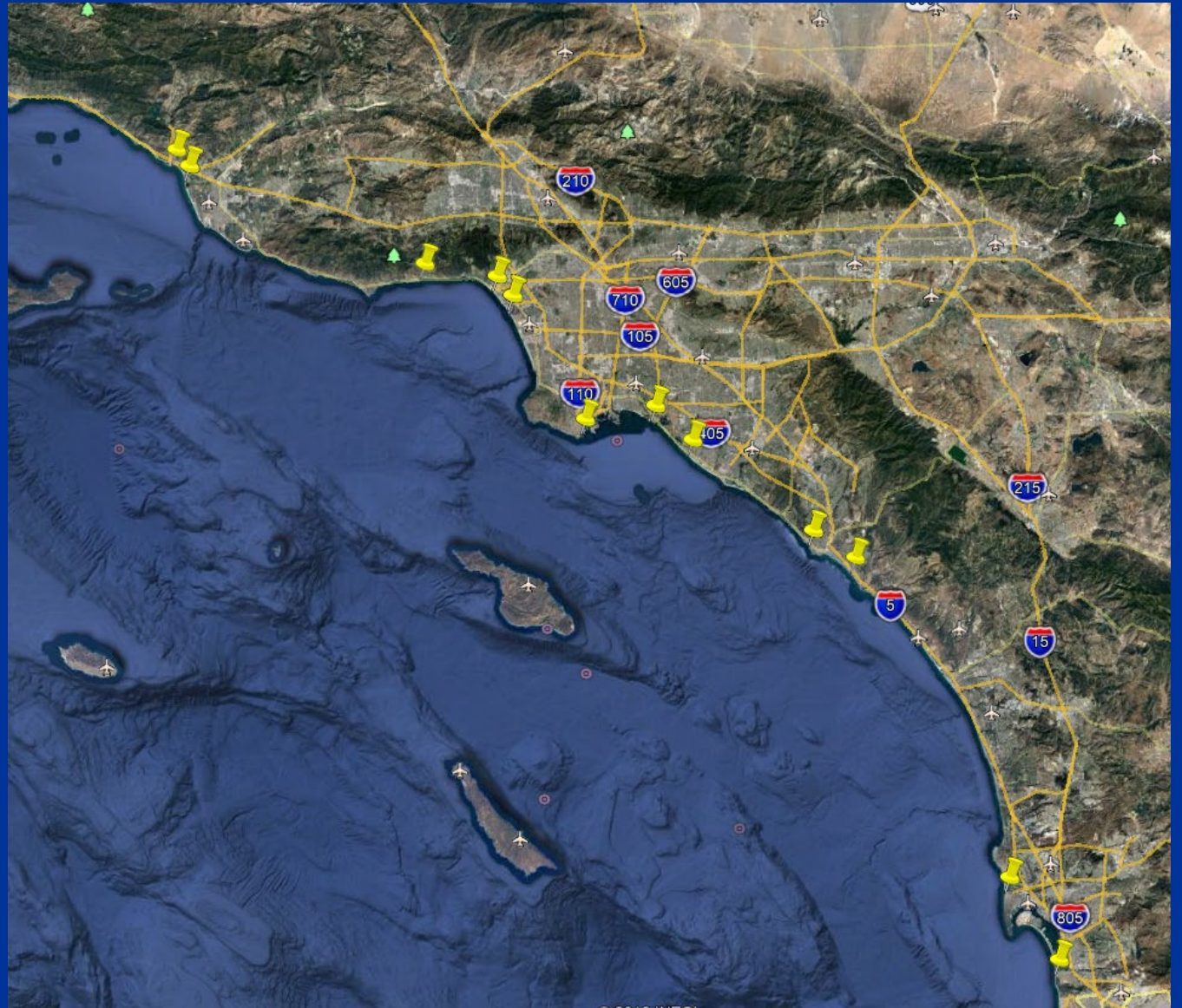
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BEACH WATER TESTING

- **12 Sites**
 - Samples collected during routine monitoring
- **Wet and Dry weather**
 - 30 samples each site and season
- **Side-by-side measurements of coliphage and *Enterococcus***

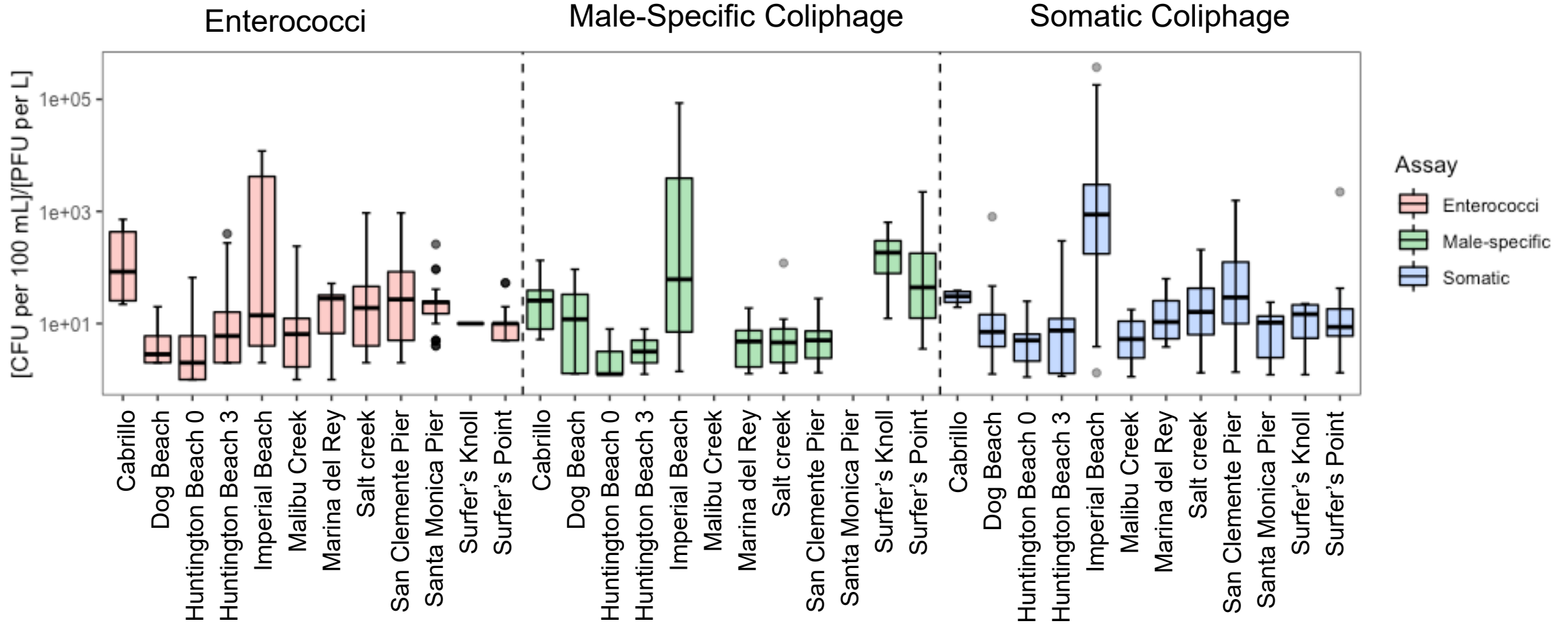
BIGHT 18' COLIPHAGE SAMPLING SITES

Monitoring Agency	Location
City of San Diego	Imperial Beach
City of San Diego	Dog Beach
OCSD	Huntington Bch Stn. 0
OCSD	Huntington Bch Stn. 3
LACSD	Inner Cabrillo
LACSD	Marina Del Rey
City of Los Angeles	Surfrider Beach
City of Los Angeles	Santa Monica Pier
OCPHL	Salt Creek
OCPHL	San Clement Pier
County of Ventura	Surfer's Point at Seaside
County of Ventura	Surfer's Knoll Beach



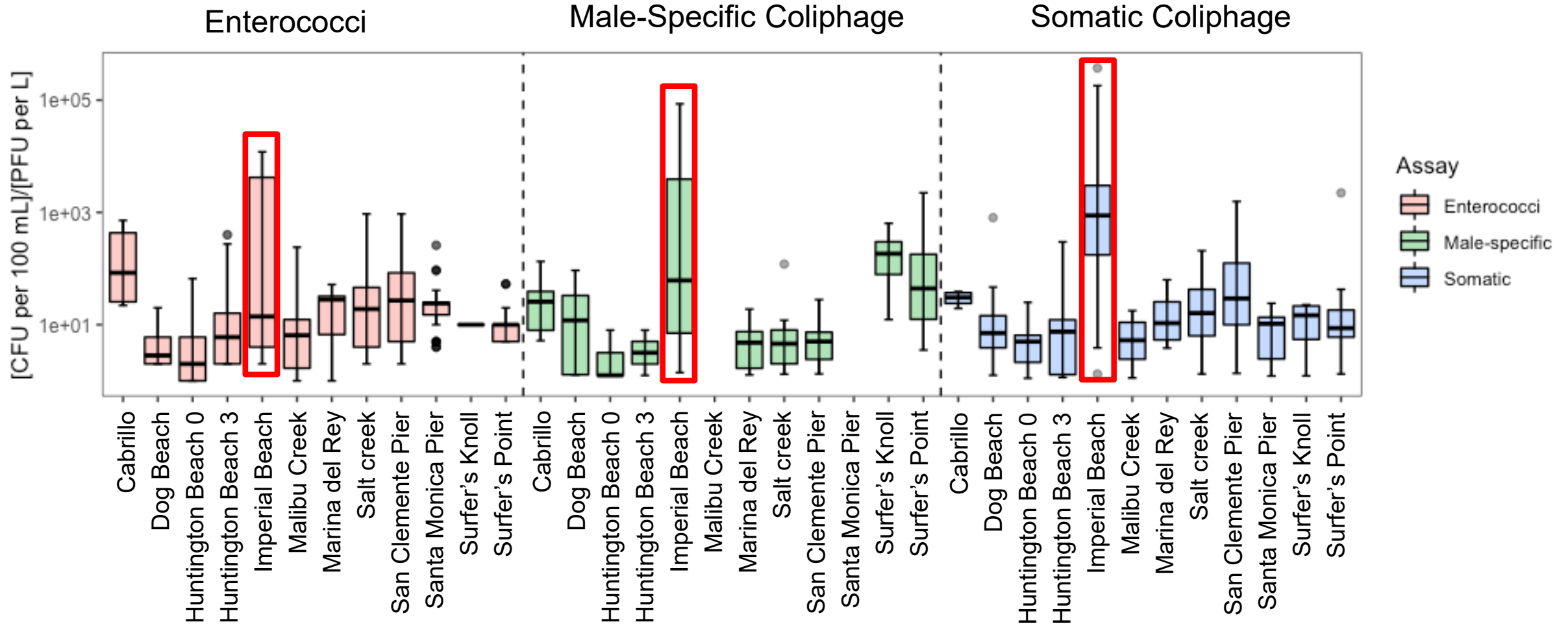
COLIPHAGE AND ENTEROCOCCUS LEVELS VARIED BY SITE

Dry Season



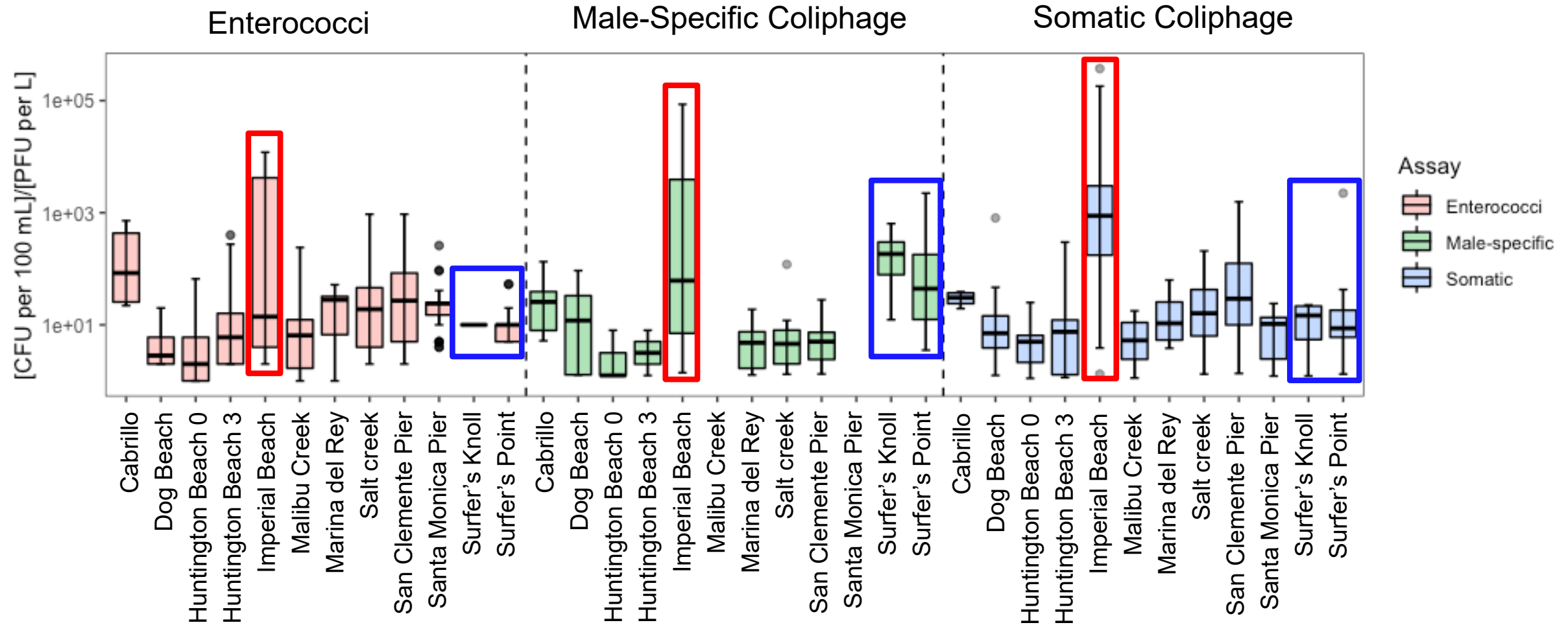
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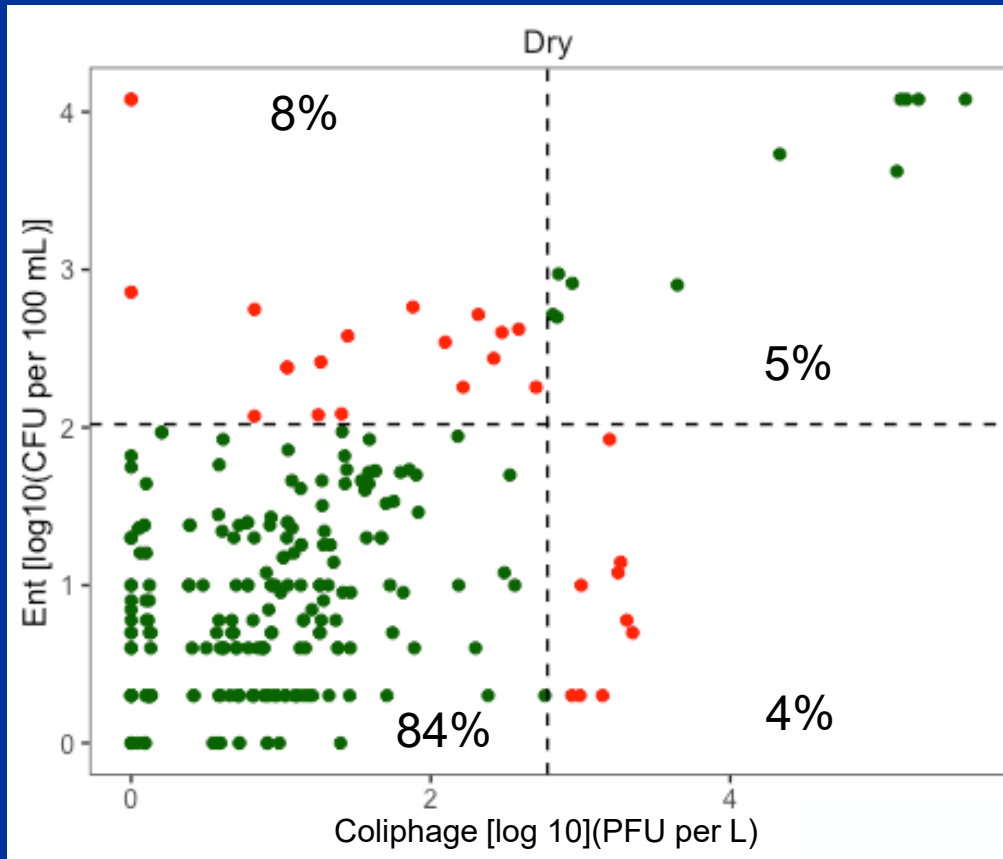


WERE LEVELS OF COLIPHAGE MEASURED PROBLEMATIC?

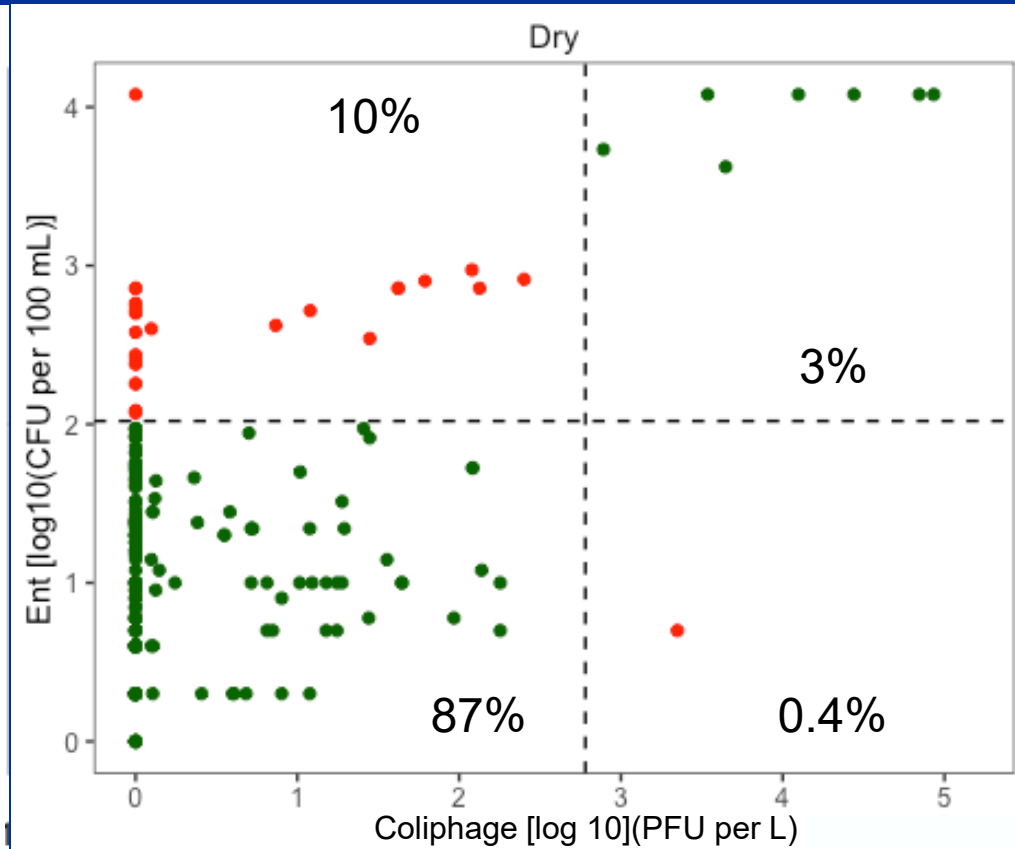
- **Currently, no EPA threshold**
- **Risk-based thresholds published for coliphage in sewage contaminated surface waters**
 - May be used to compare with risk thresholds when using current indicators
 - Somatic: 60 PFU/100 mL
 - Male-specific: 30 PFU/100 mL

COLIPHAGES VS. ENTEROCOCCUS

SOMATIC



MALE-SPECIFIC



RELATIONSHIP BETWEEN ENTEROCOCCUS AND COLIPHAGE

- **At most beaches, coliphage and Enterococcus give the same answer**
- **Beaches where coliphage is most useful**
 - Beaches affected by a disinfected wastewater discharge
 - To verify that untreated human sewage is present

YOUR NEXT CHALLENGE

- **Culture-based methods are still too slow**
 - Can't produce same-day results
 - Can't rapidly characterize the spread or dissipation of a sewage spill
- **We previously demonstrated that qPCR can produce, rapid results for Enterococcus**
 - Good agreement with culture-based methods, but had some technical problems
 - Sensitivity
 - Inhibition of chemistry by constituents in some samples
- **Digital PCR (ddPCR) solves the technical problems that stymied qPCR**
 - More sensitive – reliable measurements in the same range as culture-base methods
 - Less susceptible to inhibition – decreased likelihood of a false negative result

BIGHT '23 OPPORTUNITY

- **San Diego County Health recently gained approval from EPA and the State Board to use digital PCR data for posting beaches**
 - Their lab received ELAP certification this week
- **Multiple SCCWRP member agencies have ddPCR capability**
- **Bight '23 could be the vehicle to gain EPA approval for ddPCR beach monitoring throughout the region**
 - Similar to what we did in Bight '98 that gained approval for IDEXX