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Characterization of fecal concentrations in human and other animal sources by physical, culture-based, and quantitative real-time PCR methods

Jared S. Ervin[1], Todd L. Russell[2], Blythe A. Layton[3], Kevan M. Yamahara[5], Dan Wang[2], Lauren M. Sassoubre[2], Yiping Cao[3], Catherine A. Kelty[4], Mano Sivaganesan[4], Alexandria B. Boehm[2], Patricia A. Holden[1], Stephen B. Weisberg[3], Orin C. Shanks[4],*

[1]Earth Research Institute and Bren School of Environmental Science & Management, University of California, Santa Barbara, CA, USA
[2]Environmental and Water Studies, Department of Civil and Environmental Engineering, Stanford University, Stanford, CA, USA
[3]Southern California Coastal Water Research Project, Costa Mesa, CA, USA
[4]U.S. Environmental Protection Agency, Office of Research and Development, National Risk Management Research Laboratory, 26 West Martin Luther King Drive, Cincinnati, OH, USA
[5]Center for Ocean Solutions, Stanford University, Stanford, CA, USA

ABSTRACT

The characteristics of fecal sources, and the ways in which they are measured, can profoundly influence the interpretation of which sources are contaminating a body of water. Although feces from various hosts are known to differ in mass and composition, it is not well understood how those differences compare across fecal sources and how differences depend on characterization methods. This study investigated how nine different fecal characterization methods provide different measures of fecal concentration in water, and how results varied across twelve different fecal pollution sources. Sources investigated included chicken, cow, deer, dog, goose, gull, horse, human, pig, pigeon, septage and sewage. A composite fecal slurry was prepared for each source by mixing feces from 6 to 22 individual samples with artificial freshwater. Fecal concentrations were estimated by physical (wet fecal mass added and total DNA mass extracted), culture-based (Escherichia coli and enterococci by membrane filtration and defined substrate), and quantitative real-time PCR (Bacteroidales, E. coli, and enterococci) characterization methods. The characteristics of each composite fecal slurry and the relationships between physical, culture-based and qPCR-based characteristics varied within and among different fecal sources. An in silico exercise was performed to assess how different characterization methods can impact identification of the dominant fecal pollution source in a mixed source sample. A comparison of simulated 10:90 mixtures based on enterococci by defined substrate predicted a source reversal in 27% of all possible combinations, while mixtures based on E. coli membrane filtration resulted in a reversal 29% of the time. This potential for disagreement in minor or dominant source identification based on different methods of measurement represents an important challenge for water quality managers and researchers.