

Dr. Joshua Steele

Microbiologist

Microbiology Department

Southern California Coastal Water Research Project

Education

Ph.D., marine environmental biology, University of Southern California, 2010

B.S., molecular biology, University of California, San Diego, 2000

Professional Experience

Senior Scientist, Southern California Coastal Water Research Project, Costa Mesa, CA, 2021-present

Scientist, Southern California Coastal Water Research Project, Costa Mesa, CA. 2014-2021

Associate Research Scientist, Geobiology, California Institute of Technology, Pasadena, CA. 2013-2014

Postdoctoral Scholar in Geobiology, California Institute of Technology, Pasadena, CA. 2010-2013

Research Assistant, University of Southern California, Los Angeles, CA. 2001-2010

Knauss Marine Policy Fellow: Legislative Assistant for Rep. Sam Farr (CA-17), U.S. House of Representatives, Washington, DC. 2008-2009

Teaching Assistant, University of Southern California, Los Angeles, CA. 2001-2006

Doctoral Fellow, NSF Integrative Graduate Education, Research, and Training: Environmental Studies, Policy and Engineering- Sustainable Cities Program, University of Southern California, Los Angeles, CA 2003-2004

Participant USC Sustainable Cities Internship in Hong Kong SAR, China 2004

Sea Grant Trainee, Beach Water Quality Study, 2002

Laboratory Technician, CalBioMarine Technologies, Inc. Carlsbad, CA 2000-2001

Professional Appointments

Associate Editor, Aquatic Microbiology Section, Frontiers in Microbiology/Frontiers in Marine Science, 2021-present

California Water Quality Monitoring Council Wastewater Based Epidemiology Committee, 2021-present

Honors and Awards

Knauss Sea Grant Fellowship in Marine Policy 2008-2009

Rose Hills Graduate Internship 2005, 2006

National Science Foundation IGERT Doctoral Fellowship in Sustainable Cities 2003-2004

Student travel Award ASLO Ocean Sciences Conference, Honolulu, HI 2004

Traineeship, USC Sea Grant Program 2002

Professional Societies and Certifications

American Geophysical Union

American Society for Microbiology

Association for the Sciences of Limnology and Oceanography

Coastal and Estuarine Research Federation

Selected Presentations and Conference Proceedings

Steele, J.A., K. Langlois, K.C. Schiff, and J.F. Griffith. Application of a Microbial Community Sequencing Approach to Identify Contamination from Sewers in an Urban Watershed. ASM Microbe, American Society for Microbiology. June 15-19, 2023. Houston, TX.

Steele, J.A. Measuring Bacteria and Viruses. How do we evaluate if waters are safe to swim in or shellfish are safe to eat? California Water Boards/CASQA California Bacterial Summit September 14-16, 2022. Sacramento, CA

Rothman, J.A., A. Saghir, J.A. Steele, A.G. Zimmer-Faust, K. Langlois, J.F. Griffith, K.L. Whiteson. Longitudinal metatranscriptomic sequencing of Southern California wastewater from August 2020-21. American Society for Microbiology Microbe 2022 Washington D.C. June 9-13, 2022

Rothman, J.A., A. Saghir, J.A. Steele, A.G. Zimmer-Faust, K. Langlois, J.F. Griffith, K.L. Whiteson. Longitudinal sequencing and variant detection of SARS-CoV-2 across Southern California wastewater from April 2020 – August 2021. American Society for Microbiology Microbe 2022 Washington D.C. June 9-13, 2022

Steele, J.A., A.G. Zimmer-Faust, M.Griffith, K.Langlois, J.F. Griffith. Using Digital PCR to Track Human Fecal Pollution Onshore and Offshore at an Enclosed Urban Harbor Beach. American Society for Microbiology Microbe 2022 Washington D.C. June 9-13, 2022

Steele, J.A. COVID-19 Epidemiological Monitoring in Wastewater - Methods Development and Standardization AWWA CA-NV Fall Meeting Virtual Conference October 19, 2021

Han, L., M. Atkinson, J. Chu, M. Tilahun, J. Steele, J. Griffith, A. Zimmer-Faust. Refining Sars-cov-2 RNA Wastewater Data Analysis For Improved Relationships With Covid-19 Case Counts American Society for Microbiology and Federation of European Microbiological Societies World Microbe Forum Virtual Conference June 20, 2021

Rothman, J. A. T. B. Loveless, J. Kapcia, III, E. D. Adams, J. A. Steele, A. G. Zimmer-Faust, J. F. Griffith, N. Boyajian, J. Oval, V. J. Sharavanan, K. L. Whiteson. RNA Viromics Of Southern California Wastewater And Single Nucleotide Variant Detection Of SARS-CoV-2 American Society for Microbiology and Federation of European Microbiological Societies World Microbe Forum Virtual Conference June 20, 2021

Steele, J.A. , A. G. Zimmer-Faust, J. F. Griffith, S. B. Weisberg. Sources Of Variability In Methods For Processing, Storing, And Concentrating SARS-CoV-2 In Influent From Urban Wastewater Treatment Plants American Society for Microbiology and Federation of European Microbiological Societies World Microbe Forum Virtual Conference June 20, 2021

Journal Articles

Rothman, J.A., A. Saghir, A.G. Zimmer-Faust, K. Langlois, K. Raygoza, J.A. Steele, J.F. Griffith, K.L. Whiteson. 2024. Longitudinal Sequencing and Variant Detection of SARS-CoV-2 across Southern California Wastewater. *Applied Microbiology* 4:635-649.

Hinds, J.B., T. Garg, S. Hutmacher, A. Nguyen, Z. Zheng, J.F. Griffith, J.A. Steele, A. Gonzalez Fernandez, K.C. Schiff. 2024. Assessing the defecation practices of unsheltered individuals and

their contributions to microbial water quality in an arid, urban watershed. *Science of the Total Environment* 920:170708.

Kelly, R.P., D.M. Lodge, K.N. Lee, S. Theroux, A.J. Sepulveda, C.A. Scholin, J.M. Craine, E.A. Allan, K.M. Nichols, K.M. Parsons, K.D. Goodwin, Z. Gold, F.P. Chavez, R.T. Noble, C.L. Abbott, M.R. Baerwald, A.M. Naaum, P.M. Thielen, A.L. Simons, C.L. Jerde, J.J. Duda, M.E. Hunter, J.A. Hagan, R.S. Meyer, J.A. Steele, M.Y. Stoeckle, H.M. Bik, C.P. Meyer, E.D. Stein, K.E. James, A.C. Thomas, E. Demir-Hilton, M.A. Timmers, J.F. Griffith, M.J. Weise, S.B. Weisberg. 2024. Toward a national eDNA strategy for the United States. *Environmental DNA* DOI:10.1002/edn3.432.

Philo, S.E., K.B. De Leon, R.T. Noble, N.A. Zhou, R. Alghafri, I. Bar-Or, A. Darling, N. D'Souza, O. Hachimi, D. Kaya, S. Kim, K. Gaardbo Kuhn, B.A. Layton, C. Mansfeldt, B. Ocegüera, T.S. Radniecki, J.L. Ram, L.P. Saunders, A. Shrestha, L.B. Stadler, J.A. Steele, B.S. Steveson, J.R. Vogel, K. Bibby, A.B. Boehm, R.U. Halden, J. Delgado Vela. 2023. Wastewater surveillance for bacterial targets: current challenges and future goals. *Applied and Environmental Microbiology* DOI:10.1128/aem.01428-23.

Rabe, A., S. Ravuri, E. Burnor, J.A. Steele, R.S. Kantor, S. Choi, S. Forman, R. Batjiaka, S. Jain, T.M. León, D.J. Vugia, A.T. Yu. 2023. Correlation between wastewater and COVID-19 case incidence rates in major California sewersheds across three variant periods. *Journal of Water & Health* 21:1303-1317.

Rothman, J.A., A. Saghir, S. Chung, N. Boyajian, T. Dinh, J. Kim, J. Oval, V. Sharavanan, C. York, A.G. Zimmer-Faust, K. Langlois, J.A. Steele, J.F. Griffith, K.L. Whiteson. 2023. Longitudinal metatranscriptomic sequencing of Southern California wastewater representing 16 million people from August 2020–21 reveals widespread transcription of antibiotic resistance genes. *Journal of Water Research* 329:119421.

Zimmer-Faust, A.G., J.F. Griffith, J.A. Steele, B. Santos, Y. Cao, L. Asato, T. Chiem, S. Choi, A. Diaz, J. Guzman, D. Laak, M. Padilla, J. Quach-Cu, M. Woo, S.B. Weisberg. 2023. Relationship between coliphage and *Enterococcus* at southern California beaches and implications for beach water quality management. *Journal of Water Research* 230:119383.

Schiff, K.C., J.F. Griffith, J.A. Steele, A.G. Zimmer-Faust. 2023. Dry and Wet Weather Survey for Human Fecal Sources in the San Diego River Watershed. *Water* 15:2239.

Simons, A.L., S. Theroux, M. Osborne, S. Nuzhdin, R.D. Mazor, J.A. Steele. 2023. Zeta diversity patterns in metabarcoded lotic algal assemblages as a tool for bioassessment. *Ecological Applications* DOI:10.1002/eap.2812.

Kim, S., L.C. Kennedy, M.K. Wolfe, C.S. Criddle, D.H. Duong, A. Topol, B.J. White, R.S. Kantor, K.L. Nelson, J.A. Steele, K. Langlois, J.F. Griffith, A.G. Zimmer-Faust, S.L. McLellan, M.K.

Schussman, M. Ammerman, K.R. Wigginton, K.M. Bakker, A.B. Boehm. 2022. SARS-CoV-2 RNA is enriched by orders of magnitude in primary settled solids relative to liquid wastewater at publicly owned treatment works. *Environmental Science Water Research and Technology* 8:757-770.

Zimmer-Faust, A.G., J.F. Griffith, J.A. Steele, L. Asato, T. Chiem, S. Choi, A. Diaz, J. Guzman, M. Padilla, J. Quach-Cu, V. Ruiz, B. Santos, M. Woo, S.B. Weisberg. 2022. Assessing cross-laboratory performance for quantifying coliphage using EPA Method 1642. *Journal of Applied Microbiology* DOI:10.1111/jam.15523.

Ahmed, W., S.L. Simpson, P.M. Bertsch, K. Bibby, A. Bivins, L.L. Blackall, S. Bofill-Mas, A. Bosch, J. Brandão, P.M. Choi, M. Ciesielski, E. Donner, N. D'Souza, A.H. Farnleitner, D. Gerrity, R. Gonzalez, J.F. Griffith, P. Gyawali, C.N. Haas, K.A. Hamilton, H.C. Hapuarachchi, V.J. Harwood, R. Haque, G. Jackson, S.J. Khan, W. Khan, M. Kitajima, A. Korajkic, G. La Rosa, B.A. Layton, E. Lipp, S.L. McLellan, B. McMinn, G. Medema, S. Metcalfe, W.G. Meijer, J.F. Mueller, H. Murphy, C.C. Naughton, R.T. Noble, S. Payyappat, S. Petterson, T. Pitkänen, V.B. Rajal, B. Reyneke, F.A. Roman Jr, J.B. Rose, M. Rusiñol, M.J. Sadowsky, L. Sala-Comorera, Y.X. Setoh, S.P. Sherchan, K. Sirikanchana, W. Smith, J.A. Steele, R. Sabburg, E.M. Symonds, P. Thai, K.V. Thomas, J. Tynan, S. Toze, J. Thompson, A.S. Whiteley, J.C. Wong, D. Sano, S. Wuertz, I. Xagorarakis, Q. Zhang, A.G. Zimmer-Faust, O.C. Shanks. 2022. Minimizing errors in RT-PCR detection and quantification of SARS-CoV-2 RNA for wastewater surveillance. *Science of the Total Environment* DOI:10.1016/j.scitotenv.2021.149877.

Rothman, J.A., T.B. Loveless, J. Kapcia III, E.D. Adams, J.A. Steele, A.G. Zimmer-Faust, D. Wanless, M.L. Griffith, L. Mao, J. Chokry, J.F. Griffith, K.L. Whiteson, K. Langlois. 2021. RNA Viromics of Southern California Wastewater and Detection of SARS-CoV-2 Single-Nucleotide Variants. *Applied and Environmental Microbiology* 87:e01448-21.

Zimmer-Faust, A.G., J.A. Steele, X. Xiong, C. Staley, M.L. Griffith, M.J. Sadowsky, M. Diaz, J.F. Griffith. 2021. A Combined Digital PCR and Next Generation DNA-Sequencing Based Approach for Tracking Nearshore Pollutant Dynamics Along the Southwest United States/Mexico Border. *Frontiers in Marine Science* DOI:10.3389/fmicb.2021.674214.

Diner, R.E., D. Kaul, A. Rabines, H. Zheng, J.A. Steele, J.F. Griffith, A.E. Allen. 2021. Pathogenic Vibrio Species Are Associated with Distinct Environmental Niches and Planktonic Taxa in Southern California (USA) Aquatic Microbiomes. *mSystems* DOI:10.1128/mSystems.00571-21.

McClary-Gutierrez, J.S., Z.T. Aanderud, M. Al-faliti, C. Duvallet, R. Gonzalez, J. Guzman, R.H. Holm, M.A. Jahne, R.S. Kantor, P. Katsivelis, K.G. Kuhn, L.M. Langan, C. Mansfeldt, S.L. McLellan, L.M. Mendoza-Grijalva, K.S. Murnane, C.C. Naughton, A.I. Packman, S. Paraskevopoulos, T.S. Radniecki, F.A. Roman, A. Shrestha, L.B. Stadler, J.A. Steele, B.M. Swalla, P. Vikesland, B. Wartell, C.J. Wilusz, J.C. Ching-Wong, A.B. Boehm, R.U. Halden, K. Bibby, J.D. Vela. 2021. Standardizing data reporting in the research community to enhance the utility of open data for SARS-CoV-2

wastewater surveillance. *Environmental Science Water Research & Technology*
DOI:10.1039/d1ew00235j.

Crain, C., K. Kezer, S. Steele, J. Owiti, S. Rao, M. Victorio, B. Austin, A. Volner, W. Draper, J.F. Griffith, J.A. Steele, M. Seifert. 2021. Application of ddPCR for detection of Enterococcus spp. in coastal water quality monitoring. *Journal of Microbiological Methods*
DOI:10.1016/j.mimet.2021.106206.

Rothman, J.A., T.B. Loveless, M.L. Griffith, J.A. Steele, J.F. Griffith, K.L. Whiteson. 2020. Metagenomics of Wastewater Influent from Southern California Wastewater Treatment Facilities in the Era of COVID-19. *Microbiology Resource Announcements* 9:e00907-20.

Zimmer-Faust, A.G., J.A. Steele, J.F. Griffith, K.C. Schiff. 2020. The challenges of microbial source tracking at urban beaches for Quantitative Microbial Risk Assessment (QMRA). *Marine Pollution Bulletin* DOI:10.1016/j.marpolbul.2020.111546.

Steele, J.A., A.D. Blackwood, J.F. Griffith, R.T. Noble, K.C. Schiff. 2018. Quantification of pathogens and markers of fecal contamination during storm events along popular surfing beaches in San Diego, California. *Water Research* 136:137-149.

Arnold, B.F., K.C. Schiff, A. Ercumen, J. Benjamin-Chung, J.A. Steele, J.F. Griffith, S.J. Steinberg, P.D. Smith, C.D. McGee, R. Wilson, C. Nelsen, S.B. Weisberg, J.M. Colford Jr. 2017. Acute Illness Among Surfers After Exposure to Seawater in Dry- and Wet-Weather Conditions. *American Journal of Epidemiology* 186:866-875.

Soller, J.A., M. Schoen, J.A. Steele, J.F. Griffith, K.C. Schiff. 2017. Incidence of gastrointestinal illness following wet weather recreational exposures: Harmonization of quantitative microbial risk assessment with an epidemiologic investigation of surfers. *Water Research* 121:280-289.

Marlow JJ, Steele JA, Ziebis W, Scheller S, Case D, Reynard LM, Orphan VJ. 2017. Monodeuterated Methane, an Isotopic Tool To Assess Biological Methane Metabolism Rates. *mSphere* 2(4): e00309-17-19 doi:10.1128/mSphereDirect.00309-17.

Pasulka, A.L; Levin, L.A; Steele, J.A; Case, D.H; Landry, M. R; Orphan, V.J. 2016 Microbial eukaryotic distributions and diversity patterns in a deep-sea methane seep ecosystem. *Environ Microbiol*, 18: 3022-3043. doi:10.1111/1462-2920.13185

Cram, J. A., Chow, C.-E. T., Sachdeva, R., Needham, D. M., Parada, A. E., Steele, J. A., & Fuhrman, J. A. 2015. Seasonal and interannual variability of the marine bacterioplankton community throughout the water column over ten years. *Isme Journal* 9 (3), 563-580
doi:10.1038/ismej.2014.153

Marlow JJ, Steele JA, Case DH, Connon SA, Levin LA and Orphan VJ 2014 Microbial abundance

and diversity patterns associated with sediments and carbonates from the methane seep environments of Hydrate Ridge, OR. *Front. Mar. Sci.* 1:44. doi: 10.3389/fmars.2014.00044

Marlow, J. J., Steele, J. A., Ziebis, W., Thurber, A. R., Levin, L. A., & Orphan, V. J. 2014 Carbonate-hosted methanotrophy represents an unrecognized methane sink in the deep sea. *Nature Communications*, 5, 5094. doi:10.1038/ncomms6094

Glass, J.B., H. Yu, J.A. Steele, K.S. Dawson, S. Sun, K.Chourey, R.L. Hettich, V.J. Orphan. 2014 Geochemical, metagenomic and metaproteomic insights into trace metal utilization of methane-oxidizing microbial consortia in sulfidic marine sediments. *Environmental Microbiology* 16(6), 1592-1611. doi:10.1111/1462-2920.12314

Hatosy, S.M., J.B.H. Martiny, R. Sachdeva, J. Steele, J.A. Fuhrman, A.C. Martiny 2013 Beta-diversity of marine bacteria depends on temporal scale. *Ecology* 94 (9), 1898-1904

Chow, C.E.T., R. Sachdeva, J.A. Cram, J.A. Steele, D.M. Needham, A. Patel, A.E. Parada, J.A. Fuhrman. 2013. Temporal variability and coherence of euphotic zone bacterial communities over a decade in the Southern California Bight *ISME Journal* 7, 2259-2273; doi:10.1038/ismej.2013.122

Tavormina, P.L., W. Ussler III, J.A. Steele, S.A. Cannon, M.G. Klotz, V. J. Orphan. 2013. Depth distribution of Cu-MMO variants through the oxygen minimum zone along the Costa Rica convergent margin. *Environmental Microbiology Reports* 5 (3), 414-423

Gilbert, J.A., J.A. Steele, J.G. Caporaso, L. Steinbrück, P. Somerfield, J. Reeder, B. Temperton, S. Huse, I. Joint, A.C. McHardy, R. Knight, J.A. Fuhrman, D. Field. 2012 Defining seasonal marine microbial community dynamics. *ISME Journal* 6:298-308.

Steele, J.A., P.D. Countway, L. Xia, P. D. Vigil, J.M. Beman, D.Y. Kim, C. T. Chow, R. Sachdeva, A.C. Jones, M.S. Schwalbach, J. M. Rose, I. Hewson, A. Patel, F. Sun, D.A. Caron, J.A. Fuhrman. 2011 Marine bacterial, archaeal, and protistan association networks reveal ecological linkages *ISME Journal* 5:1414-1425.

Xia, L. C., J.A. Steele, J. Cram, Z.G. Cardon, S.L. Simmons, J.J. Vallino , J.A. Fuhrman, F. Sun 2011. Extended local similarity analysis (eLSA) of microbial community and other time series data with replicates. *BMC Systems Biology* 5:S15.

Beman, J.M., J.A. Steele, and J.A. Fuhrman. 2011 Co-occurrence patterns for abundant marine archaeal and bacterial lineages in the deep chlorophyll maximum of coastal California. *ISME Journal* 5:1077-1085.

Fuhrman J.A., J.A. Steele. 2008 Community Structure of Marine Bacterioplankton: Patterns, Networks, and Relationships to Function. *Aquatic Microbial Ecology* 53:69-81.

Fuhrman, J.A., J.A. Steele, I. Hewson, M. S. Schwalbach, M.V. Brown, J. Green, Brown, J.H. 2008 A Latitude Diversity Gradient in Planktonic Marine Bacteria. *Proceedings of the National Academy of Sciences* 105:7774-7778.

Patel, A., R. Noble, J.A. Steele, M.S. Schwalbach, I. Hewson, J.A. Fuhrman 2007 Virus and Prokaryote Enumeration from Planktonic Marine Environments by Epifluorescence Microscopy with SYBR Green I. *Nature Protocols* 2:269-276.

Ruan, Q., D. Dutta, M.S. Schwalbach, J.A. Steele, J.A. Fuhrman, F. Sun 2006 Local Similarity Analysis Reveals Unique Associations Among Marine Bacterioplankton Species and Environmental Factors. *Bioinformatics* 22: 2532-2538.

Fuhrman, J. A., Hewson, I., Schwalbach, M. S., Steele, J. A., Brown, M. V., & Naeem, S. 2006. Annually reoccurring bacterial communities are predictable from ocean conditions. *Proceedings of the National Academy of Sciences*, 103(35): 13104–13109.

Ruan, Q., Steele, J. A., Schwalbach, M. S., Fuhrman, J. A., & Sun, F. 2006. A dynamic programming algorithm for binning microbial community profiles. *Bioinformatics*, 22(12), 1508-1514.

Hewson, I., D.G. Capone, J. A. Steele, J.A. Fuhrman. 2006 Influence of Amazon and Orinoco Offshore Surface Water Plumes on Oligotrophic Bacterioplankton Diversity in the West Tropical Atlantic. *Aquatic Microbial Ecology* 43:11-22.

Hewson, I, J.A. Steele, D.G. Capone, J.A. Fuhrman. 2006 Remarkable Heterogeneity in Meso- and Bathypelagic Bacterioplankton Community Composition. *Limnol. Oceanography* 51:1274-1283.

Hewson, I, J.A. Steele, D.G. Capone, J.A. Fuhrman. 2006 Temporal and Spatial Scales of Oligotrophic Surface Water Bacterioplankton Assemblage Variation. *Marine Ecology Progress Series* 311:67-77.

Steele, J.A., F. Ozis, J.A. Fuhrman, J.S. Devinny. 2005. Structure of Microbial Communities in Ethanol Biofilters. *Chemical Engineering Journal* 113:135-143.

Technical Reports

Steele, J.A., D. Ebentier, A.G. Zimmer-Faust, J.F. Griffith, K.C. Schiff. 2019. Los Coches Creek Microbial Source Tracking Study. Technical Report 1087. Southern California Coastal Water Research Project. Costa Mesa, CA.

Schiff, K.C., J.F. Griffith, J.A. Steele, A.G. Zimmer-Faust, J.A. Soller. 2019. Inner Cabrillo Beach Microbial Source Tracking and Quantitative Microbial Risk Assessment (QMRA). Technical Report

1068. Southern California Coastal Water Research Project. Costa Mesa, CA.

Steele, J.A., J.F. Griffith, R. Noble, K.C. Schiff. 2017. Tracking Human Fecal Sources in an Urban Watershed During Wet Weather. Technical Report 1002. Southern California Coastal Water Research Project. Costa Mesa, CA.

Schiff, K.C., J.F. Griffith, J.A. Steele, B. Arnold, A. Ercumen, J. Benjamin-Chung, J.M. Colford Jr, J. Soller, R. Wilson, C. McGee. 2016. The Surfer Health Study: A Three-Year Study Examining Illness Rates Associated with Surfing During Wet Weather. Technical Report 943. Southern California Coastal Water Research Project Authority. Costa Mesa, CA.