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Pathogenic Viruses and Bacteria in Storm Water Discharging to Beaches with Year-round Surfer Populations in San Diego, California

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Abstract

Microbial water quality, usually measured by fecal indicator bacteria (FIB), at California beaches near storm drains worsens following storms, leading to well-known 72-hour rain advisories. However, until recently, the pathogenic bacteria and viruses in storm water that likely cause illness could not be reliably measured. This was primarily due to the difficulty in quantifying dilute pathogens in complex water matrices. Digital PCR assays now have the sensitivity to enable direct quantification of pathogenic viruses and bacteria. Using digital PCR assays, we measured microbial water quality in storm water discharges that drained into two beaches with large, year-round surfer populations, during wet-weather seasons in San Diego, CA. Tourmaline Creek drained a small urban watershed and the San Diego River drained a large mixed urban/undeveloped watershed. Storm water was collected during six events with precipitation ranging from 0.19-2.5" from January-March 2014 and December 2014-March 2015. Microbial water quality was determined by quantifying FIB, *Campylobacter*, *Salmonella*, human Norovirus, adenovirus, and enterovirus. We found high FIB and pathogen concentrations in both the large and small watershed storm water during and in the 3 days following rainfall. Norovirus type GII and *Campylobacter* spp. were detected most frequently, while *Salmonella* and adenovirus were rarely detected, and enterovirus was not detected. We found no relationship between FIB and pathogen concentration. The ability to quantify pathogens in storm water provides the ability to more precisely determine the microbial contamination. This direct quantification will also enable better risk estimates and improve management at non-point source pollution affected beaches.