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Fecal Indicator Bacteria (FIB) Levels During Dry Weather from Southern California Reference Streams

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ABSTRACT

High levels of fecal indicator bacteria (FIB) in surface waters is a common problem in urban areas that often leads to impairment of beneficial uses such as swimming or other contact recreation. Once impaired, common management and regulatory solutions include development of Total Maximum Daily Loads (TMDLs) and other water quality management plans. A critical element of these plans is establishment of a "reference" level of exceedances against which to assess management goals and TMDL compliance. Unfortunately, existing "background" or reference data on contributions of FIB from undeveloped catchments during dry weather is limited to a small number of locations measured at few time points. The goal of this study was to provide information on indicator bacteria contributions from natural streams in undeveloped catchments throughout southern California during dry weather, non-storm conditions. Specific questions addressed were: a) What are the "background" ranges of concentrations of FIB associated with dry weather flow from reference areas? b) What is the frequency with which reference FIB levels exceed relevant water quality standards? c) How does seasonality influence stream FIB levels associated with reference areas? and d) How do the ranges of FIB concentrations associated with reference areas compare with those associated with urban (developed) areas? To help establish a regional reference data set, bacteria levels (i.e. *Escherichia coli* (*E. coli),* enterococci and total coliforms)) were measured from 15 unimpaired streams in 11 southern California watersheds weekly for one full year. A total of 590 water samples were collected from spring 2006 through spring 2007. Results were compared with data from the developed Ballona Creek watershed and to established State of California bacteria standards. Concentrations measured from reference areas were typically between one to two orders of magnitude lower than levels found in developed watersheds. The absence of *B. thetaiotaomicron* indicated that the FIB in reference streams were likely of non-human origin. Nearly 82% of the time, samples did not exceed daily and monthly bacterial indicator thresholds, demonstrating good bacteriological water quality in natural streams throughout southern California. *E. coli* had the lowest daily percent exceedance (1.5%). A total of 13.7% of enterococci exceeded daily thresholds. The average measured enterococci levels of these exceedances was 292 MPN/100 mL, with a maximum of 2098 MPN/100 mL and a minimum of 160 MPN/100 mL. Indicator bacteria levels fluctuated seasonally with an average of 79% of both enterococci and total coliforms exceedances occurring during summer months (June-August). Temperature, at all sites, explained about one-half the variation in total coliforms density suggesting that stream temperatures regulated bacterial populations. Studies of human health risk associated with natural bacteria levels have not been conducted, but the levels observed in this study are below those reported to cause risk in freshwater systems with known human sources of FIB. Accounting for natural background levels will allow for management targets that are more reflective of the contributions from natural sources. Additional monitoring during wet weather is warranted to further characterize background bacterial contamination in southern California reference waterbodies.

Full Text

ftp://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/542_FIB_ReferenceBacti.pdf