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Relationships among bacterial indicators during a regional survey of microbiological water quality along the shoreline of the Southern California Bight

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ABSTRACT

A regional shoreline microbiology study was conducted in order to examine microbiological water quality along the entire shoreline of the Southern California Bight (SCB). A major goal of the study was to compare the responses among indicator bacteria. Samples were collected weekly at 307 sites between Point Conception, California, and Punta Banda, Mexico, beginning August 2, 1998, and continuing for five weeks. Three analytical methods, multiple tube fermentation (MTF), membrane filtration (MF), and chromogenic substrate tests, were used to test for the three bacterial indicators currently used in southern California for human water-contact health standards: total and fecal coliforms, and enterococci. Samples were collected using standardized protocols. Total and fecal coliforms were analyzed for all samples, and enterococci were measured in approximately 70% of the samples. Sampling sites were selected using a stratified random design, with six sampling strata: high- and low-use sandy beaches and rocky shoreline, and ephemeral and perennial freshwater outlets. Results demonstrated that total and fecal coliforms correlated strongly with one another ($r = 0.93$). The correlation between enterococci and either total or fecal coliforms was much lower, but still significant ($r = 0.29$). However, these correlation coefficients were produced by including 564 values that had qualifiers; i.e., $<$ or $>$ symbols qualified the discreet value. Analysis of the data without the qualified results demonstrated stronger correlations between enterococci and fecal coliforms ($r = 0.40$) and enterococci and total coliforms ($r = 0.77$). No indication was found that the relationship between one bacterial indicator and another was dependent upon strata. However, the probability of exceeding a bacterial indicator threshold differed substantially between the indicators. The allocation of threshold exceedences among indicators was very dependent upon the indicator examined. Enterococci alone exceeded the bacterial indicator thresholds most often; i.e., one out of every three bacterial indicator exceedences was for enterococci alone. This finding demonstrated that enterococci was by far the most “conservative” indicator of bacteriological water quality in this study. Less than one-half of the enterococci threshold exceedences paired with threshold exceedences of another indicator, while nearly 90% of the total and fecal coliform threshold exceedences were partnered with exceedences of another indicator. These results shed new light on the quantitative assessments of bacteriological water quality and the interpretation of the results of bacteriological water quality analyses.

Full Text

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