

## Sources of Fecal Indicator Bacteria in Urban Streams and Ocean Beaches, Santa Barbara, California

### Abstract

Fecal indicator bacteria (FIB) concentrations in urban streams and ocean beaches in Santa Barbara, Calif. can exceed water-quality standards for recreational water. During low flow, high FIB concentrations in urban streams were associated with point discharges from storm drains, and concentrations in urban streamflow varied three-fold over the course of a day as a result of small variations in storm drain discharge. Human-specific *Bacteroides* was present in some sampled storm drains. FIB concentrations were highest in stormflow runoff, although concentrations decreased as successive storms washed FIB from the urban watershed. Sources of FIB to near-shore ocean water included surface discharges from urban streams, and fecal material from birds associated with kelp and sand along the beachfront. FIB concentrations were higher during the ebb of the “spring” tide and decreased to less than the detection limit during low tide when  $^{222}\text{Rn}$  and electromagnetic seepmeter data show ground-water discharge to the ocean was greatest. Ground-water discharge and leakage from sewer lines were not sources of FIB to near-shore ocean water. Interpretations of the sources of FIB from Principal Component Analysis (PCA) of genetic (T-RFLP), molecular (PLFA), and trace-organic (such as caffeine, fecal sterols, and detergent metabolites) data generally agreed with interpretations supported by physical measures of water flow. The most robust PCA results were from PLFA data which explained 97 percent of the total variance within the first and second principal components. Less variance was explained in PCA analysis of T-RFLP and trace-organic data, although these tracers captured relations not apparent in PLFA data. Certain compounds lent themselves to specific interpretations on the origin of FIB. The T-RFLP data indicated an unexpectedly large diversity of microorganisms, including FIB, in shallow ground water where street runoff was discharged to beach sands.