Better methods improve measurements of recreational water quality

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The concentration of enterococci, bacteria that thrive in feces, has long been the federal standard for determining water quality. Researchers have now shown that the greatest influences on that concentration are the

quantity of mammalian feces in the water, and the numbers of enterococci that glom onto floating particulate matter. The research is published Friday, July 13 in *Applied and Environmental Microbiology*, a journal of the American Society for Microbiology.

"We also found that ecosystem specific characteristics, such as freshwater sediment and freshwater transport to the estuary are important influences on enterococci concentrations in coastal recreational and shellfish harvest waters," said Stephen Jones, Ph.D. Dr. Jones is Research Associate Professor, University of New Hampshire, and Associate Director, New Hampshire Sea Grant Program.

Recreational waters can harbor an array of different bacterial pathogens, the investigators noted in their paper. Human fecal pollution is the biggest concern for public health, as there is no inter-species barrier to transmission to humans. "But other fecal sources that contain enterococci and possibly human pathogens can be chronic or intermittent sources of both, making beach water quality management and remediation efforts more complex," the investigators wrote.

Dr. Jones and his student and coauthor Derek Rothenheber, collected water samples weekly at Wells, Maine, during the summer of 2016. In 2014, two of the town beaches had been flagged for intermittently exceeding state standards for concentrations of enterococci, and advisories had occasionally been posted warning the public that the waters might be unhealthy—bad publicity for a beach town. But by 2016, the Wells Beach area was meeting state of Maine standards.

Besides the beach area, the investigators sampled freshwater tributaries of the coastal watershed, and marine beach water near the outlet of the estuary, said Dr. Jones. They also sampled sediments in tributaries and in the estuary, and soil from areas surrounding the tributaries, to enable molecular analyses of microbial communities in water, sediments, and

soils from the different ecosystems. They also measured water temperature, salinity, and acidity, as well as weather conditions.

Dr. Jones and Mr. Rothenheber used polymerase chain reaction (PCR) to identify the animals that were the sources of fecal material, and they used metagenomic DNA sequencing to characterize the bacterial composition of water, sediment, and soil samples from the different ecosystems," said Dr. Jones.

Several agencies in the state of Maine have now adopted the researchers' methodology for assessing areas with water quality issues, and the investigators have been sharing their findings at conferences, with other scientists and resource managers, in order to spread their techniques for monitoring water quality.

The US Environmental Protection Agency established water quality regulations based on enterococci as the indicator of fecal-borne pollution, to help manage water quality at estuarine and marine beaches.

Dr. Jones noted that enterococci are versatile organisms that thrive not only in the colon, but also in soil and in the sedimentary layers of lakes, rivers, and marine waters. "Our study pulls together the multiple fecal sources, the diverse environmental reservoirs, and the changeable environmental conditions to assess how these variables can all influence enterococci concentrations in a coastal setting," said Dr. Jones. "No other study has taken such an encompassing and robust approach towards addressing the issue of the factors that influence enterococci concentrations in coastal waters."

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