



WATER RESOURCES RESEARCH GRANT PROPOSAL

Title: The Evaluation of Several Chemical Indicators of Fecal Pollution in Relationship to Standard Microbiological Indicators.

Category:

Keywords: Bacteria, Indicators, Tropical Waters, Fecal

Duration: March, 1999 to February, 2000

Fiscal Year 1999 Federal Funds: Total \$42,968

Non-Federal Funds Allocated: Total N/A

Principal Investigators: Dr. Gary R.W. Denton Harold R. Wood WERI, University of Guam
Dr. N.K. Suleman Division of Natural Sciences University of Guam
Co Investigators Anna Maria E.D. Leon Guerrero Catalina Valmonte Poblete Guam
Environmental Protection Agency

Congressional District of University Performing Research: NA

Statement of the Critical State or Regional Water Problem

Infectious agents that have gained entrance into recreational waters pose a significant health risk to people using those waters in a variety of ways. Human pathogens may enter recreational waters from a variety of sources. By far the greatest risk involves contact with water that has been polluted with human fecal waste. Human fecal waste, potentially, contains a wide variety of pathogenic organisms that can cause illness and disease in humans. As the population base that the fecal waste is derived from increases in size, the potential for risk increases as well, both in terms of the quantitative amount of specific pathogen present and the number of different types of pathogens present. The greatest risk to the public is water contaminated with community derived human fecal waste or sewage. Therefore it is important to define the risk to the public utilizing the recreational waters.

Since 1972 the US Environmental Protection Agency (US EPA) and since 1978 the Guam Environmental Protection Agency (GEPA) has required analysis of recreational waters for indicator organisms in an attempt to define the risk of waterborne and water contact disease to the public. Originally that indicator standard was Fecal Coliform bacteria. These are the coliform bacteria that commonly occur in the human gut and feces. A health advisory was issued for those recreational areas with fecal coliform counts in excess of 200 colony forming units (CFU) per 100 mL. In 1986 this standard was changed to reflect decreased confidence in the Fecal Coliform test in representing disease-associated risk. Currently US EPA mandates and GEPA uses the Enterococcus

Test for the evaluation of marine waters and Escherichia coli (E. coli) for evaluation of recreational fresh waters. Enterococcus is a subgroup of the fecal streptococci and E. coli is one species of the fecal coliform group. It has been determined, at least in temperate waters, that the presence of significant numbers of either of these two groups indicates an increased risk of waterborne and/or water contact disease. The current standard for marine waters is 35 cfu of enterococcus / 100 mL. The fresh water standard is 126 cfu E. coli / 100 mL. It should be noted that GEPA does not use the preferred enterococcus test in fresh waters due to the inability to meet the mandated standard because of high counts of enterococcus.

In recent years, even the utility of Enterococcus and E. coli as indicators of increased risk, especially in the tropics, has come into question (McNeil 1992). Both of these organisms have been shown to be able to live for prolonged times, and even multiply in tropical environments. The US EPA is currently seeking methods which more reliability correlate with increased risk of water associated disease. The proposed study will quantitate current microbiological indicators (enterococcus and E. coli) and a proposed microbiological indicator (Clostridium perfringens) with several chemical indicators of human fecal pollution (fecal lipids, urobilin and caffeine). Although the microbiological studies have been done on Guam, they have never been calibrated against chemical indicators that are relatively unambiguous indicators of human fecal contamination.

Statement of Results, Benefits, and/or Information Expected

Currently, recreational waters are monitored on a weekly basis for federally mandated indicators of fecal pollution. In the case of marine waters that indicator is enterococcus. In the case of freshwaters that indicator is E. coli. Health advisories are made on the basis of the numbers of the respective indicator. It is clear that human fecal pollution is associated with increased risk of waterborne and water contact disease. Because there is concern that these indicators do not necessarily indicate risk in our tropical waters, the proposed study will evaluate the current (and proposed) microbiological standards in relationship to several relatively unambiguous chemical indicators of human fecal pollution. Chemical indicators have been advocated because they have several advantages over the customary microbiological indicator organisms. Many waters, especially waters in tropical areas, have levels of common indicator organisms that do not seem to be associated with recent fecal pollution and thus do not reflect current risk of acquiring disease.

Results of this study will help elucidate the utility of the currently used microbiological indicators in Guam's tropical climate. It is hoped that the study will indicate which indicators are most appropriate and in which settings. It may well turn out that none of the currently used indicators are useful. An evaluation of the chemical indicators in terms of technological feasibility, cost and rapidity of analysis will be provided.

Nature, Scope, and Objectives of the Research

The research is designed to:

A. Evaluate the presence and quantities of several microbiological indicators in Guam's recreational waters. These indicators would include *Enterococcus*, *Escherichia coli* and *Clostridium perfringens*.

B. Quantitate the presence of several chemical indicators of fecal pollution, including fecal sterols, caffeine and urobilin. Since the fecal sterols and urobilin are associated with the particulate fraction, analysis will be performed on surface sediments as well as water samples.

C. Correlate the various microbiological indicator levels with each other and with these relatively unambiguous chemical indicators of fecal pollution.

D. Study degradation rates of the chemical indicators under environmental conditions.