American Samoa is a U.S. Territory in the South Pacific that lies about 2,600 miles southwest of Hawaii. It comprises five high volcanic islands and two coral atolls whose total area is 76.2 square miles. The islands are characterized by rugged volcanic mountainsides, small valleys, and a narrow coastal fringing reef. The largest island, Tutuila, has an area of 33,920 acres and is home to 96% of the 69,544 population. It receives about 200 inches of rain annually with a hurricane season extending from November to February. Nearly all villages obtain their drinking water from 60 deep municipal wells. But some outlying villages still depend upon—and many elderly raised drinking surface water prefer—drinking water from some of the 141 perennial streams draining Tutuila’s 33 watersheds.
Residents from villages along Tutuila’s southeast coast, dependent upon the American Samoa Power Utility, ASPA, for their drinking water, have found their drinking water nearly unpalatable during the past few years. As a consequence, many either purchase bottled water or revert to drinking unhygienic stream water.

What has been done: Because ASPA does not have a local laboratory for monitoring total dissolved solids (TDS) during their monthly surveillance for *E. coli* and coliform contamination, we offered to sample tap water from 20 widely distributed villages on Tutuila. Measuring TDS, electrical conductivity (EC), and levels of calcium, magnesium, potassium, and sodium, we found that villages in the Western District have relatively pure water (EC < 0.4 mS cm$^{-1}$) and those along the southeast coast have a high concentration of electrolytes (EC > 500 mS cm$^{-1}$) in their tap water. Because we could not test for chloride, the Na/Mg ratio in the samples suggested that the high EC was caused by seawater infiltration into the groundwater of wells serving this area.

Results: We shared our findings with ASPA water engineers and with the local EPA, ASEPA. The engineers determined that wells from the village of Aua, on the east side of Pago Harbor, were the main wells serving the southeastern villages, and that they were being overdrawn. No immediate solution was offered, but a long term plan would be to dilute water from these wells with purer water from wells on the northeast shore via the distribution system. This information will be used to help ASPA prioritize its water capital improvement projects Priority Project List to comply with ASEPA and EPA rules and regulations.

Establishing an Index of Stream Biological Integrity

**Issue:** Biological monitoring of the nation’s rivers and streams has proved useful for assessing their health and integrity, as mandated by the Clean Water Act of 1987, and for identifying ecological risks that are important to human health and well-being.

**What has been done:** We selected five highly impacted and five relatively pristine streams on Tutuila for our comparison. Some of the latter were accessible only by kayak. Using electrofishing to capture crustaceans and fishes, and hand-collecting snails, we sampled mid-reaches of these streams for the distribution and abundance of these macrofauna.

**Results:** We did not find a significant difference in the presence or abundance of any of the macrofauna that would be useful in constructing an index of biological integrity. We did learn that most of the macrofauna were fairly common and widely distributed throughout the tropical Pacific. With the help of expert taxonomists, we were able to enhance the ability of both amateurs and professionals to identify our stream animals using an illustrated guide. We also produced and distributed posters of each fauna group to all private and public schools in the Territory so that children could gain an appreciation for protecting these animals by protecting the streams.


“Freshwater Snails of American Samoa.” Poster. Ibid. No. 51
“Freshwater Shrimps of American Samoa.” Poster. Ibid. No. 52
“Freshwater Fishes of American Samoa.” Poster. Ibid. No. 53
“Animals in American Samoa Streams.” Poster. Ibid. No. 54.

**Issue:** Something strange was happening in Pago Pago Harbor. The normally deep blue water took on a color resembling red primer. Some speculated that boats from the commercial fishing fleet were illegally polluting the harbor. Others feared the eruption of an undersea volcano. We were asked to find out.

**What has been done:** At the suggestion of a marine biologist, we collected samples of harbor water for microscopic examination. We found the samples teeming with what the biologist identified as the dinoflagellate, *Ceratium furca*. We followed up with more samples, pairing counts of this algae with concentrations of nitrogen and phosphorus.

**Results:** We found an excellent match between algae counts and the total nitrogen level in the samples. We notified the local EPA office and the press to assuage any fears. Subsequent visits to sites around the harbor for evidence of piggery or septic tank leaks soon pointed to the source of the excess nitrogen: a newly established soccer field adjacent to the mouth of a stream emptying into the head of the harbor. The field manager was treating the turf with weekly applications of ammonium sulfate in order to prepare for its grand opening. Suggestions by one of our Cooperative Extension Service agents on best management practices convinced the manager to greatly reduce the application rate of fertilizer. The result was the disappearance of the bloom and a substantial savings in fertilizer costs.
**Issue:** One suspected cause of an algal bloom in Pago Pago Harbor in 2007 was the use of high phosphate detergents imported into the Territory from the Orient, Fiji, and Mexico. We decided to determine whether these detergents contained high levels of phosphate and to determine which detergents were implicated.

**What has been done:** We assigned this task to a high school honors student as a class assignment. She collected samples of laundry detergent thought to contain phosphate. As a control she used Tide from Proctor and Gamble, since phosphates have long been banned in detergents used in the United States. She measured both reactive P and total P on twelve laundry products using the ascorbic acid method with and without persulfate digestion, respectively.

**Results:** One consequence of the algae bloom was the Governor’s issuing Executive Order No. 010-2007 banning all high-phosphate detergents (greater than 11%) from the Territory. Our high school honors student found that three products—Cold Power (from Fiji), Ariel and Ariel with Downy (from Mexico)—contained 1-2% phosphate. Except for Tide, which had no detectable phosphate, all of the others contained less than 0.5% phosphate (despite claiming on their labels that they contain no phosphate). Although the Governor’s order did not address the real issue regarding phosphate, the local EPA and other local agencies hope to strengthen the order based, in part, on our student’s findings, to ban detergents containing any measureable phosphate.

Leptospirosis in Stream Waters

**Issue:** The bacterial disease, leptospirosis, is a public health threat in American Samoa. Urine from commonly suspected vectors—pigs, dogs, and rodents—enters streams, where the bacteria can enter and infect humans through ingestion or through breaks in the skin.

**What has been done:** Working with the local EPA and Department of Health, and especially with Dr. Colleen Lau from the School of Population Health, The University of Queensland, Australia, we have been educating the public on the risks of infection and means to minimize exposure to polluted water.

**Results:** With local and international partners, we produced a brochure in both Samoan and English describing leptospirosis, how it is transmitted, and how to best avoid becoming infected. In addition, signs have been posted near streams warning of the possibility of the stream water being contaminated with the bacteria. Dr. Lau has issued posters and written peer-reviewed journal articles on the subject. These are given below. A planned project to isolate leptospirochetes from our streams using a technique described by a colleague from the University of Nevada, Reno, did not take place owing to a failure of the technique to consistently filter out the leptospirochetes in laboratory trials.

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