Applying knowledge to improve water quality

Southwest States & Pacific Islands Regional Water Program

A Partnership of USDA NIFA & Land Grant Colleges and Universities

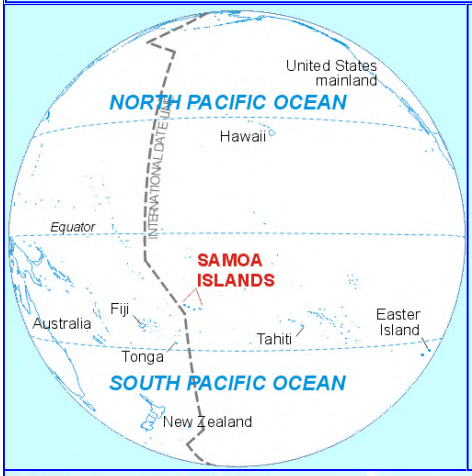
American Samoa Community College
Community & Natural Resources

Final Report on Water Quality Program—American Samoa

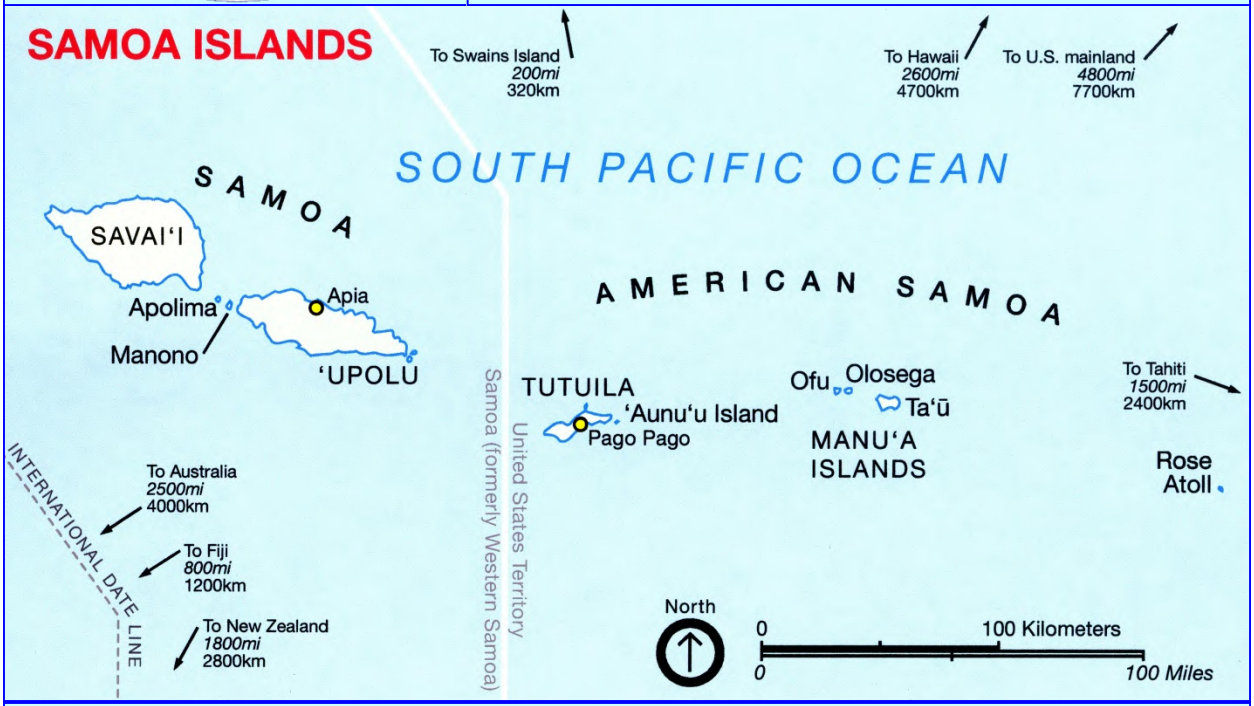
Technical Report No. 58

August 2013

Sharon Fanolua Sunia & Don Vargo, Co-Coordinators



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.



The American Samoa Community College, Community and Natural Resources, PO Box 5319, Pago Pago, AS 96799. This work was supported by Award #Y550080 from the University of Arizona, Kitt Farrell-Poe, PhD, Region 9 Water Quality Coordinator, Southwest States and Pacific Islands Regional Water Quality Program.

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Why Does My Water Taste Awful?

Issue: 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.

Sunia SF & D Vargo. 2012. Electrical Conductivity and Major Cation Concentrations in Municipal Water from Tutuila Island, American Samoa. Tech. Rpt. No. 57. http://www.ctahr.hawaii.edu/adap/ASCC_LandGrant/technical_papers.asp.

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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.

"Stream Fauna of American Samoa: An illustrated guide to snails, shrimps, and fishes of American Samoan streams." Available at: http://www.ctahr.hawaii.edu/adap/ASCC_LandGrant/technical_papers.asp as No. 55.

"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.

Wade, LM, FS Fanolua, AM Vargo, K vanHoute-Howes, E. Bardi, and DL Vargo. Exploiting Macrofauna Diadromy for Assessing Anthropogenic Impact in American Samoa Streams. Pacific Science (2008). Vol. 62,No. 2:177-190.

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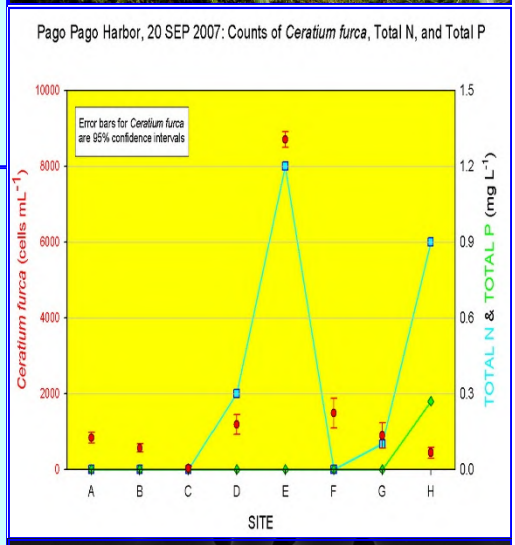
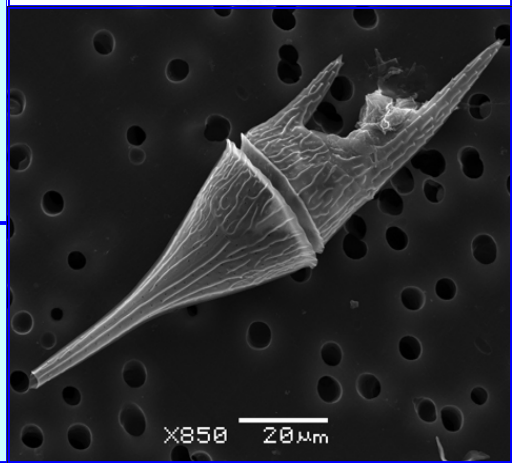
Red Tide Algal Bloom in Pago Pago Harbor

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 teaming 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.



Morton, SL, A Shuler, J Paternoster, S Fanolua, and D. Vargo. Coastal eutrophication, land use changes and *Ceratium furca* (Dinophyceae) blooms in Pago Pago Harbor, American Samoa 2007-2009. Chinese Journal of Oceanology and Limnology, Vol. 29 No. 4 p. 790-794. 2011.

Red Tide Algal Bloom, Pago Pago Harbor. S. Fanolua & D Vargo. 2011. Available at: http://ag.arizona.edu/region9wq/pdf/WQ%20Success%20Story%20Am%

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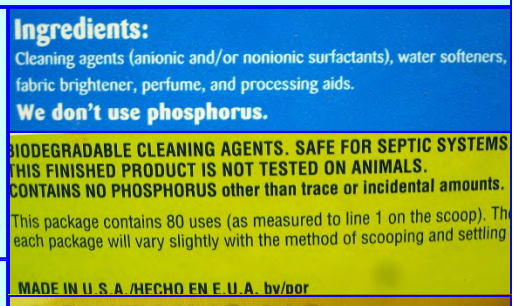
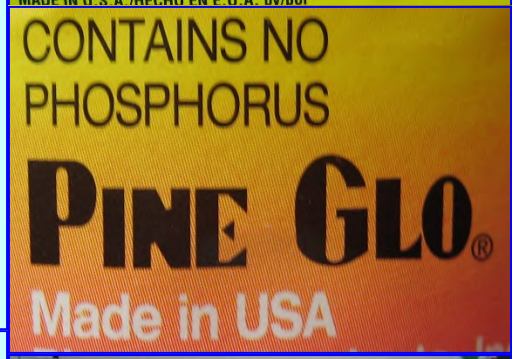
Phosphates in Laundry Detergents

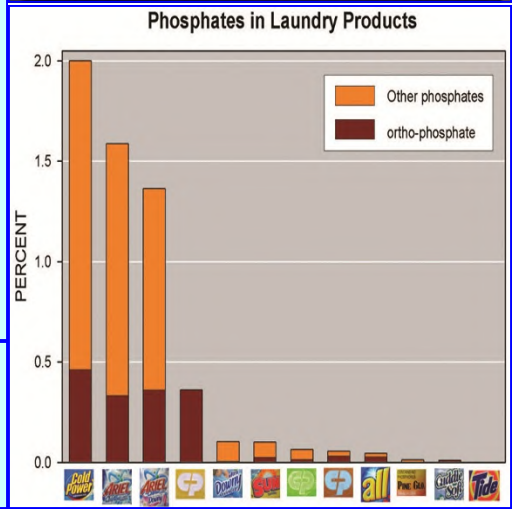
Issue: One suspected cause of an algal bloom in Pago Pago Harbor in 2007 was the use of high phosphate detergents imported into the Territory from the Orient, Fiji, and Mexico. We decided to determine whether these detergents contained high levels of phosphate and to determine which detergents were implicated.



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.



Red Tide Algal Bloom, Pago Pago Harbor. S. Fanolua & D Vargo. 2011. Available at: http://ag.arizona.edu/region9wq/pdf/WQ%20Success%20Story%20Am%20Samoa.pdf .

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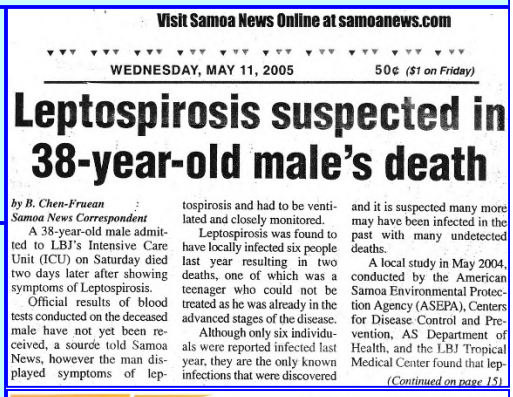
Leptospirosis in Stream Waters

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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WEDNESDAY, MAY 11, 2005 50¢ ($1 on Friday)

Leptospirosis suspected in 38-year-old male's death

by B. Chen-Fruean
Samoa News Correspondent

A 38-year-old male admitted to LBJ's Intensive Care Unit (ICU) on Saturday died two days later after showing symptoms of Leptospirosis.

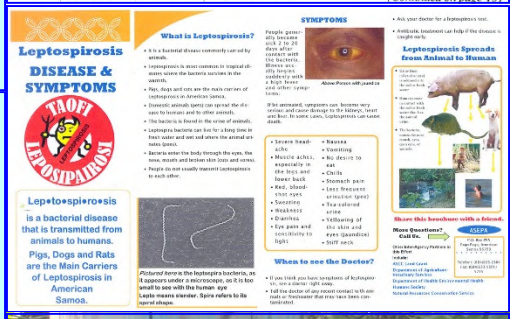
Official results of blood tests conducted on the deceased male have not yet been received, a source told Samoa News, however the man displayed symptoms of leptospirosis and had to be ventilated and closely monitored.

Leptospirosis was found to have locally infected six people last year resulting in two deaths, one of which was a teenager who could not be treated as he was already in the advanced stages of the disease.

Although only six individuals were reported infected last year, they are the only known infections that were discovered and it is suspected many more may have been infected in the past with many undetected deaths.

A local study in May 2004, conducted by the American Samoa Environmental Protection Agency (ASEPA), Centers for Disease Control and Prevention, AS Department of Health, and the LBJ Tropical Medical Center found that lep-

(Continued on page 15)



Leptospirosis
DISEASE & SYMPTOMS

TAOFI LEPOSIPAIROSI

Lepetospierosis is a bacterial disease that is transmitted from animals to humans.

Pigs, Dogs and Rats are the Main Carriers of Leptospirosis in American Samoa.

What is Leptospirosis?

SYMPTOMS

When to see the Doctor?

Leptospirosis Spreads from Animal to Human

American Samoa Leptospirosis Study 2010: Preliminary Report #1—September 2010. Available from: colleen.lau@uq.edu.au.

Lau C, L Smythe, E. Fearnley, S Craig, and P Weinstein. Climate Change, Flooding, and Leptospirosis: Fuelling the Fire? Climate Change, Health, and Ecology Conference. Sept 1-3, 2010. Uppsala, Sweden. doi:10.1016/j.trstmh.2010.07.002.

Lau C, AJ Dobson, LD Smythe, EJ Fearnley, C Skelly, ACH Clements, SB Craig, SD Fuimaono, and P Weinstein. Leptospirosis in American Samoa 2010: Epidemiology, Environmental Drivers, and the Management of Emergence. Am.J.Trop. Med. Hyg. 86(2), 2012, pp. 309-319.

Lau C, C Skelly, LD Smythe, SB Craig, and P Weinstein. Emergence ofnew leptospiral serovars in American Samoa—ascertainment or ecological change? BMC Infectious Diseases, 2012, 12:19. doi: 10.1186/1471-2334-12-19.