

Nutrient Enrichment and Nitrogen Isotopic
Analysis of Kahawai and Waimanalo Streams to
Investigate Factors Regulating Nitrate
Concentrations

Lucas H. Mead
Senior Thesis
Summer, 2003

OCN 499
Under the direction of:
Edward A. Laws, Ph.D.,
Department of Oceanography,
University of Hawaii at Manoa

Abstract:

Kahawai and Waimanalo streams are located on the windward side of the island of Oahu, Hawaii. Kahawai stream is a tributary to Waimanalo stream and contributes significantly to the nutrients in the resulting stream. Upstream of the Kalaniana'ole Highway bridge, the channel of the Kahawai tributary has been cemented (hardened) for purposes of flood control. The channel is 50 feet wide, and the resulting stream is broad and shallow with no sediment layer. In the final report "Investigations of Waimanalo and Kane'ohē Streams", Tomlinson et al. (2001) recorded water temperatures in the hardened part of Waimanalo stream to be on average 25.6 °C, with temperatures as high as 38.2 °C being recorded. Water temperatures between 26 and 28 °C were also measured in the hardened section of the stream in another study (Laws, 2003). Downstream of the bridge there has been an attempt to reconstruct the natural stream environment. Native plants have been planted along the bank of the tributary, and the stream is narrower, deeper and has a thick sediment layer. Despite the natural channel and deeper water, the temperature is still about 4 °C above the ambient water temperature of the natural stream (Laws, 2003).

High nitrate levels in Kahawai stream on the order of 500 μM have been noted upstream of the convergence with Waimanalo stream. At the convergence of Kahawai and Waimanalo streams, the nitrate level drops down (most likely due to dilution). After the convergence, the stream flows onto property owned by the Bellows Air Force Base. Sampling has not occurred between the area downstream of the convergence and the

mouth of the Waimanalo stream (on Bellows Air Force Base property). At the mouth of Waimanalo stream, the nitrate levels drop to single or low double digits. High nutrient levels in a stream can be problematic since the fertilization of water can lead to a biological bloom that could consume dissolved oxygen and starve other organisms.

Previous studies of Kahawai stream suggest that the stream is autotrophic in the hardened section. This conclusion is based on high pH values and O₂ concentrations that exceed saturation (Laws, 2003). The stream's dissolved oxygen concentration drops below saturation after the hardened section of the stream, suggesting that the area encompassed by this study is net heterotrophic. The combined nitrate and nitrite in the stream remain high due to a lack of phosphate and one or more other elements. The lack of these nutrients prevents at least some of the uptake and assimilation of nitrate through biological activities in the streams. Denitrification is a metabolic process used for respiration in areas of low oxygen concentration (Deutsch et al., 2001). Denitrification may be removing some of the nitrate in the heterotrophic areas of Kahawai stream. If so, one would expect the nitrate nitrogen to become isotopically heavier due to preferential use of ¹⁴N for denitrification. However, isotopic analysis of nitrate in the stream did not reveal such a pattern.

Purpose:

The purpose of this research is to investigate some factors regulating nitrate concentrations in Kahawai and Waimanalo streams, through nutrient enrichment and denitrification experiments.