Ka Wai Ola o Kānewai: Characterizing the sediments, nutrients and microbial communities of an indigenous flooded agro-ecosystem

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ABSTRACT

Land use change has decreased the total area of natural wetlands in Hawai‘i (Van Rees & Reed, 2014). With the disappearance of wetlands, ecosystem functions that are critical to the protection of coastal marine habitats are lost (Koshiba *et al.,* 2013; Fabricius, 2005). Flooded agroecosystems for the production of kalo (*Colocasia esculenta*) have the potential to provide ecosystem services of wetlands like sediment and nutrient trapping (Koshiba *et al.*, 2013). Kalo cultivation in irrigated flooded agroecosystems is widespread throughout Oceania, with the most extensive systems being the lo`i kalo of Hawai‘i (Kirch, 1993). The potential of lo‘i to function as sediment traps or in providing nutrients to the natural environment has not been investigated previously. In this study we measured a number of water quality parameters including total suspended sediment, dissolved organic carbon, dissolved nitrogen and ammonium from Mānoa Stream and Ka Papa Lo`i o Kānewai, an upland lo‘i within the same catchment, during high and low flow conditions from June – July 2015. This upland lo`i system removed suspended sediments, especially during storm flow conditions. Higher concentrations of dissolved organic carbon, total dissolved nitrogen, and dissolved ammonium were measured from water flowing through the lo`i system as compared to the stream, but small sampling size did not reveal a significant difference. To compare the microbial communities from stream and lo‘i sediment, high-throughput sequencing was performed on sediment samples from the stream and lo`i. The core microbial community structure of the lo‘i comprised 136 unique operational taxonomic units (OTUs) as compared to only 13 OTUs in the core stream community. Our results suggest that soils from lo`i support a more diverse core community of microbes. Previous work

has shown that the growth of kalo directly influences microbially mediated nutrient cycling pathways (Penton *et al.*, 2013). Taken together, our data indicate that lo`i have the capacity to utilize inputs of nutrients and sediments from the natural stream for the production of kalo and effectively decrease the delivery of sediments to coastal habitats. Future studies of lo`i across an elevation gradient may help to elucidate the complex ecosystem services of lo`i and inform restoration of these agroecosystems in Hawai‘i.