Decadal-scale impacts of mangrove removal: Re-evaluation of sediment characteristics and transport >10-years after mangrove removal in Tauranga Harbor, New Zealand

Final Report:

Mangroves occupy a unique position as the only woody plant that grows in the intertidal zone. They directly impact coastal stability and morphology, yet isolating the role of mangroves in geomorphic evolution is challenging. Understanding the impact of mangrove extent on coastal evolution is critical for both interpreting stratigraphic records and predicting future changes to vulnerable coastlines.

Waikaraka Estuary in Tauranga Harbour, Aotearoa New Zealand (A-NZ) provides an opportunity to identify the drivers of estuary evolution as mangrove extent increased and decreased over the past century. The original goals of this project were to collect data in Waikaraka Estuary in order to evaluate the current mangrove distribution and the characteristics of the upper 1 meter of sediment; identify important sediment transport processes over tidal to century timescales; and compare these results to existing regional data on morphology, sediment supply, and hydrodynamics. Additional numerical modeling was conducted to examine the historical hydrodynamic regime in the estuary and the impact of varying mangrove extent over the past century.

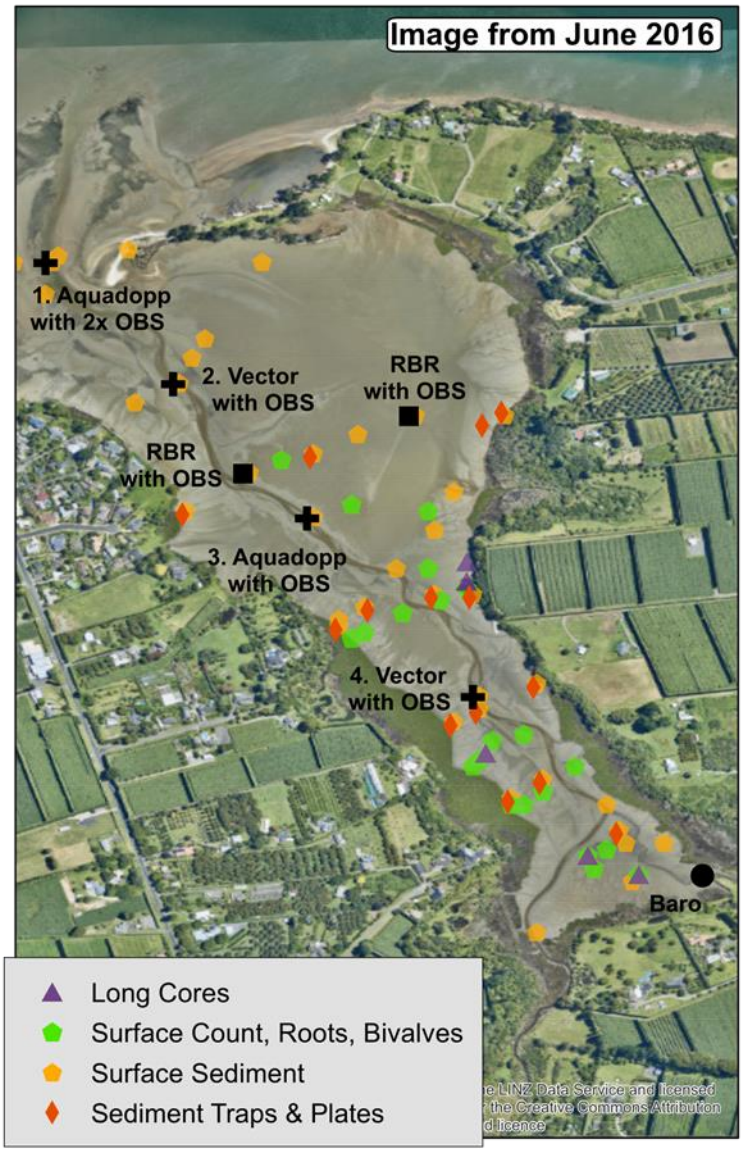
The in-situ hydrodynamic data and sediment cores demonstrated that the modern Waikaraka Estuary is close to a stable equilibrium and has not changed significantly since mangrove removal in 2005. Sediment transport is dominated by tidal processes, which are controlled by the bathymetry of the estuary. The modern mangroves do not play a significant role in estuarine sediment dynamics. The numerical modeling and geochronology of the sediment cores demonstrated that the estuary infilled due to an increase in coastal sediment supply coupled with continual tidal processes. The mangroves expanded to cover the estuary only after these infilling processes had begun.

These field measurements and numerical modeling have increased our understanding of the complex interactions between biotic and abiotic processes in coastal geomorphology. Intertidal sediment dynamics were controlled by tide and wave processes, sediment supply, existing morphology, and mangrove characteristics. This study has highlighted the importance of considering site-specific parameters and intra-estuary variability when assessing the impact of mangrove removal. The results contribute directly to the QRC mission of investigating linked earth-systems in order to better understand past, present, and future change.

This work was supported by a diverse network of organizations. The QRC provided critical funding for travel to the field site, consumable fieldwork supplies, and lab analysis of sediment cores. Logistical support and travel funds were provided by the Limnology and Oceanography Research Exchange (LOREX) program run by the Association for the Sciences of Limnology and Oceanography (ASLO), which aims to build international collaborations through joint research. The Office of Naval Research provided salary support. Finally, the Alyn and Alison Duxbury Endowed Student Support Fund is providing funding to publish the results in an open access journal to increase the accessibility of the findings.

Images for website:

Hannah Glover in Waikaraka Estuary in June 2019 with supplies for coring and surveying (photo credit: Debra Stokes).



Aerial image of Waikaraka Estuary with the locations of field instrumentation and sample collection in June 2019.