NFWF Progress Report September 2017 to Coral Reef Alliance

Project title: Local Engagement for Conservation Solutions: Measuring the Impact of
Management Action in South Kohala, Hawai'i Island
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Plan: Monitoring will be conducted between Spring 2017 and Spring 2018 with 3 water quality
samplings and 1 benthic survey per year along the Puakō – Mauna Lani coast on Hawai'i Island
to establish baseline water quality and benthic conditions prior to a sewage pollution remediation
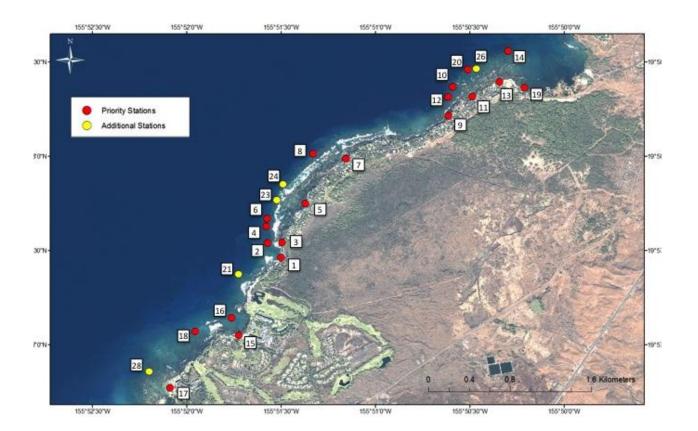project at Puakō.

Work completed to date: Prior to sampling, the proposed sampling design was reexamined, and
the Principal Investigators decided that a modified before-after-control-impact (BACI) design
was best for assessing the success of a future sewage pollution remediation project at Puakō.
Using this BACI design, shoreline and offshore benthic stations were selected with input from
University of Hawai'i at Hilo (UHH) and The Nature Conservancy (TNC). Several of the
selected stations were UHH or TNC long-term monitoring ones. The number of stations
proposed to be sampled changed due to the higher number of stations needed to statistically
detect change in benthic communities, and the financial and time constraints of collecting water
samples at all stations. The final design included 10 paired, priority shoreline and offshore
benthic stations (20 stations total) for water quality sampling and benthic surveys (Fig. 1, red
circles; Table 1, gray highlight, priority #1). Six of the priority stations were considered to be in
areas of high sewage impact according to a sewage pollution scoring system developed in a prior
project (Abaya et al. in revision), two were in medium and low sewage impact areas,
respectively, and the remaining two stations were located at resorts south of Puakō. These latter
two priority stations are considered "reference" stations as the resorts have a sewage treatment
plant and its effluent is used for irrigation of a sod and tree farm. It is unlikely that sewage
treatment at these resorts and any resulting coastal inputs of sewage will change in the
foreseeable future. Lastly, benthic surveys were conducted at five "additional" stations (Fig. 1,
yellow circles; Table 1, white highlight, priority #2), one station surveyed was in the high
sewage impacted area, two in the low sewage impacted area, and the last two in the "reference"
area.

At the priority stations (shoreline and offshore benthic), water samples were collected
and analyzed for fecal indicator bacteria (*Enterococcus* spp., *Clostridium perfringens*), nutrients
($NO_3^-+NO_2^-$, NH_4^+, PO_4^{3-}, H_4SiO_4, TDN, TDP), salinity, pH, and turbidity. Seaweed samples
were also collected at these locations and analyzed for stable isotopes of nitrogen ($\delta^{15}N$).
Samples were collected in the morning at low-tide. Water quality and seaweed samples were
analyzed at the UHH Analytical Laboratory using standard procedures. To date, two water
quality surveys have been completed (May – July 2017, September 2017). All samples have
been submitted to the UHH Analytical Laboratory, and most have been analyzed, except for the
most recent sampling. The last trip for water quality sampling at the priority sites is planned for
January 2018.

In June 2017, benthic surveys were conducted at priority and additional stations (Fig. 1,
Table 1). These stations were located at the edge of the bench and/or at 3-5 m water depth. The
priority offshore benthic stations were located parallel to its paired shoreline station (Table 1).

At each benthic station, a 10-m transect line was placed on the benthos running parallel to shore. To quantify % coral and algal cover, 1-m^2 photo-quadrats were conducted along the transect lines. These photo-quadrats will be analyzed for benthic cover (% coral and algal cover) using Coral Point Count with Excel extensions (CPCe). Algae and coral will be identified to the lowest possible taxon at randomly generated points within each photograph to yield a percent cover. Additionally, all corals within a half meter on both sides of the transect line were surveyed, and species and the presence of direct coral-algal competition were recorded, for a total survey area of 10-m^2 at each station. For colonies with direct coral-algal competition, the algal species was identified to the lowest possible taxon. These data are currently being entered and will provide information on the % of the coral community at each station experiencing direct coral-algal competition. Algal height was also measured every 20 cm down the transect line with a ruler. These measurements in conjunction with % algal cover data from the photo-quadrats will be used to calculate benthic algal biomass. In the first and last 2 m of each transect line, the maximum coral colony diameter was measured to the nearest 5 cm for colonies larger than 5 cm, and to the nearest 1 cm for colonies smaller than 5 cm, for a total of 4, 1-m^2 quadrats/transect. These data will provide the population size structure of various coral taxa and coral recruit density.

Figure 1. Stations selected for baseline monitoring at Puakō, Hawai'i. At priority stations (red) water quality sampling and benthic survey were conducted. At "additional" stations (yellow, priority 2), only benthic surveys were conducted. Shoreline and offshore benthic stations were selected from long-term monitoring ones from University of Hawai'i at Hilo (UHH) and The Nature Conservancy (TNC). Details regarding the stations used for this project can be found in Table 1.

Table 1. Locations of stations selected for baseline monitoring at Puakō, Hawai'i. (Project Station). Shoreline and offshore benthic stations were selected from long-term monitoring ones from University of Hawai'i at Hilo (UHH) and The Nature Conservancy (TNC) (Organization). Previous station codes used by these organizations are listed under Organization Station. Priority shoreline and offshore benthic stations (Sampling Priority 1), where water quality sampling and benthic surveys took placed, are shaded in gray. Paired priority shoreline (odd #) and offshore benthic (even #) stations are located next to one another in the table and share the same shade of gray. Additional stations (Sampling Priority 2), where only benthic surveys were conducted, are in white. Sewage pollution scores were determined from Abaya et al. in revision.

Project Station	Organization	Organization Station	Latitude (°N)	Longitude (°W)	Station Location	Sampling Priority	Sewage Pollution Score
1	UHH	1	19.957700	-155.858310	Shoreline	1	Low
2	TNC	10	19.958996	-155.859515	Offshore	1	Low
3	UHH	2	19.959050	-155.858220	Shoreline	1	High
4	TNC	16	19.960471	-155.859635	Offshore	1	High
5	UHH	4	19.962500	-155.856190	Shoreline	1	High
6	TNC	17	19.961155	-155.859550	Offshore	1	High
7	UHH	7	19.966450	-155.852600	Shoreline	1	High
8	TNC	28	19.966876	-155.855487	Offshore	1	High
9	UHH	11	19.970250	-155.843520	Shoreline	1	High
10	TNC	30	19.972818	-155.843143	Offshore	1	High
11	UHH	12	19.971950	-155.841430	Shoreline	1	Medium
12	TNC	4	19.971907	-155.843577	Offshore	1	Medium
13	UHH	13	19.973250	-155.839020	Shoreline	1	High
14	TNC	39	19.975990	-155.838270	Offshore	1	High
15	UHH	Fairmont Lagoon	19.950850	-155.862060	Shoreline	1	Reference
16	TNC	13	19.952381	-155.862703	Offshore	1	Reference
17	UHH	Mauna Lani	19.946180	-155.868120	Shoreline	1	Reference
18	TNC	14	19.951196	-155.865926	Offshore	1	Reference
19	UHH	14	19.972750	-155.836850	Shoreline	1	High
20	TNC	25	19.974327	-155.841821	Offshore	1	High
21	TNC	21	19.956230	-155.862080	Offshore	2	Reference
23	TNC	23	19.962799	-155.858703	Offshore	2	Low
24	TNC	24	19.964210	-155.858140	Offshore	2	Low
26	TNC	26	19.974420	-155.841080	Offshore	2	High
28	TNC	28	19.947630	-155.869980	Offshore	2	Reference

References:

Abaya, L.M., T.N. Wiegner, S. Colbert, J. Beets, K.M. Carlson, K.L. Kramer, R. Most, and C. Couch. A multi-indicator approach for identifying shoreline sewage pollution hotspots adjacent to coral reefs. In revision with Marine Pollution Bulletin, submitted April 2017, revising September 2017.

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