National Coral Reef Monitoring Program

Climate Monitoring Brief: St. Thomas and St. John, USVI, 2023

NOAA/Atlantic Oceanographic & Meteorological Laboratory (AOML) Coral Program

University of Miami Cooperative Institute of Marine and Atmospheric Studies (CIMAS)

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Diver swapping out a temperature instrument at Newfound Reef, St. John USVI

Mission

The AOML Coral Program tracks the status and trends of coral reef ecosystems of the U.S. Atlantic and Caribbean as part of the National Coral Reef Monitoring Program (NCRMP). This summary brief provides an overview of the most recent climate monitoring efforts in St. Thomas and St. John (US Virgin Islands).

Expedition summary

- The NCRMP Atlantic climate monitoring team surveyed St. Thomas and St. John from July 19th to July 29th, 2023.
- Twenty-seven different sites were visited by four team members and collaborators completing a total of 68 dives.

Data collection summary

Subsurface temperature: Subsurface temperature recorders (STRs) were recovered and redeployed at seven transects, each one composed of four depths (Fig. 1). In total, more than 10 million temperature observations were collected from 26 instruments (Table 1).

NCRMP Climate fixed sentinel site monitoring: At Brewers Bay - 5m site, located in St. Thomas, short term instruments (72h) were deployed to monitor daily fluctuations in:

- **Current**: 303 observations
- **pH**: 307 observations
- **Light**: 301 observations
- **Carbonate Chemistry**: 17 samples collected

Table 1: Number of temperature observations collected by transect and depth.

Site ID	Site Name	1m	5m	15m	25m	Total
STT North	Inner Brass	148,882	138,022	626,111	439,058	1,352,073
STT South	Brewers Bay	625,219	354,882	488,880	455,315	1,924,296
STJ West	Steven's Cay	138,804	554,763	621,498	579,392	1,894,457
STJ South	Tektite	624,720	591,584	335,248	562,830	2,114,382
STJ East	Newfound	139,666	431,320	548,123	623,809	1,742,918
STT West	Savana	NA	80,756	438,556	470,210	989,522
STJ North	Johnson's	NA	489,383	300,495	583,640	1,373,518

Habitat persistence: Changes in bioerosion and calcification were monitored:

- **Carbonate budget surveys**: Benthic cover, sponge, urchin, and parrotfish surveys completed at six transects
- **Bioerosion**: 70 Bioerosion Monitoring Units (BMUs) collected, 70 redeployed
- **Calcification**: 35 Calcification Accretions Units (CAUs) collected, 35 redeployed

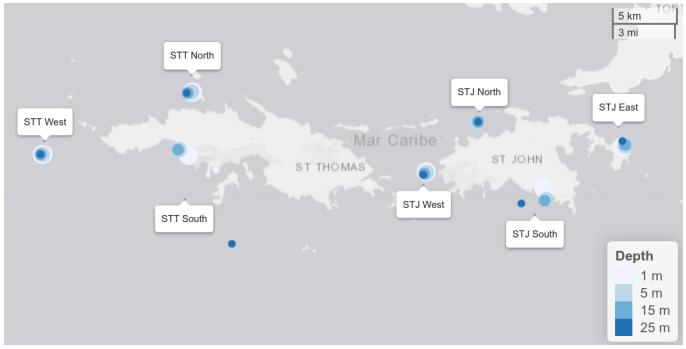

Figure 1: *Study sites and depths in St. Thomas and St. John USVI. All study areas have 4 depth points associated with them except for the north transect of St. John and the west transect in St. Thomas.*

Subsurface temperature

The temperatures that marine organisms experience are a function of local oceanographic conditions and vary with depth. To monitor subsurface temperature, seven transects were established around the two islands. Each transect consists of STRs at four depths (1, 5, 15, 25m; Fig. 2). Temperature was measured using SeaBird Electronics Subsurface Temperature Recorders (STR)s that collected data at 5-minute intervals.

The instruments are usually swapped every three years for data collection but the COVID - 19 pandemic delayed field work in 2020. Local contractors were hired to swap the instruments as NOAA travel was not allowed. Gaps exist in the data as not all instruments survived the extended deployment time. The full time series of data from 2017 - 2023 at all six locations and all four depths are provided to allow for temporal and spatial comparison of subsurface temperature.

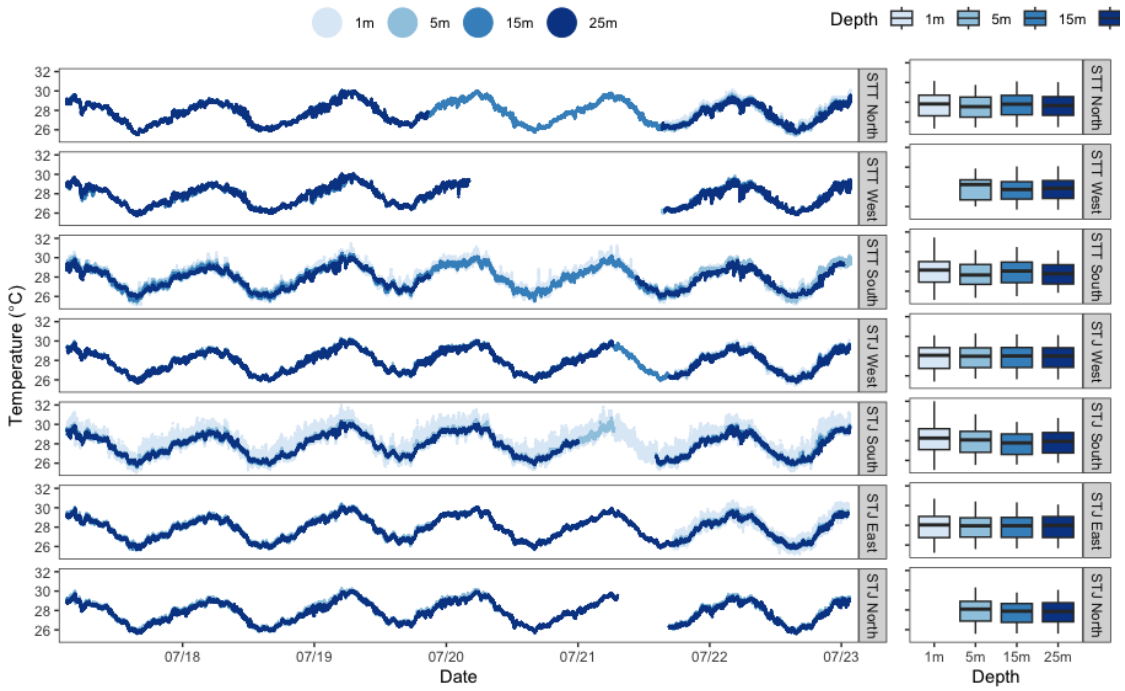

Figure 2: *Temperature conditions at seven locations in St. Thomas and St. John (Savana, Inner Brass, Brewers Bay and Southwaters, Stevens Cay, Johnson's Reef, Tektite) representing a depth gradient (1m, 5m, 15m and 25m). Data were collected from August 2017 to July 2023.*

Mean temperature values were similar among the locations and depths. The lowest temperatures generally occurred in February (mean: 26.2°C, min: 25.0°C, max: 29.1°C) and the highest temperatures in September (mean: 29.3°C, min: 27.1°C, max: 32.1°C). Temperature values in the shallow (1m) South transects at STT and STJ were more variable compared to the rest of the stations (Fig. 2).

Diurnal suite deployment

Seawater carbonate chemistry can fluctuate diurnally due to biological forcing processes such as photosynthesis and respiration, as well as calcification and dissolution. To characterize this, discrete water samples (Fig. 3) were collected at three-hour intervals (n=15) using Subsurface Automatic Samplers (SAS, www.coral.noaa.gov/accrete/sas).

These samples will be analyzed for Total Alkalinity (TA), Dissolved Inorganic Carbon (DIC), and Spectrophotometric pH (SpecpH), which will be used to calculate pCO_2 and aragonite saturation state ($\Omega_{Aragonite}$). A suite of instruments was deployed for a 72-hour period at the Brewers Bay 5m site. A SeaFET was used to log pH, an EcoPAR measured Photosynthetically Active Radiation (PAR), and a Lowell Tiltmeter measured current speed and direction. Each instrument collected measurements at 15-minute intervals (Fig. 3).

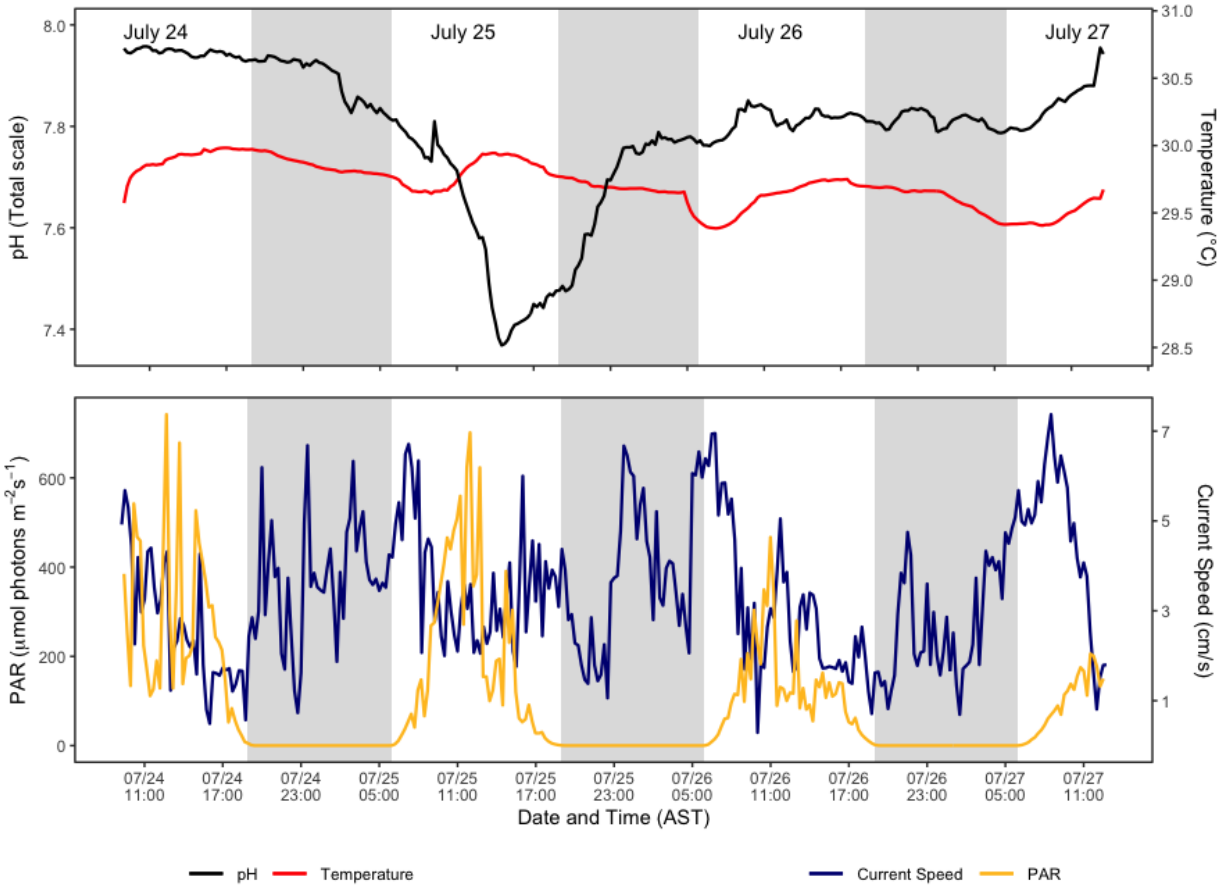

Figure 3: *Data from Brewers Bay diurnal suite monitoring from July 24th to July 27th. Top panel: pH and temperature from SeaFET. Bottom panel: Photosynthetically Available Radiation (PAR) and current speed from EcoPAR and Tiltmeter. Shading denotes nighttime throughout the sequence of the plot. Instruments measured parameters every 15 minutes.*

Habitat persistence

Carbonate budget assessments use transect-based surveys (*ReefBudget*, Perry et al. 2012) to quantify the abundance of carbonate producers (e.g., corals and crustose coralline algae, CCA), and carbonate bioeroders, (e.g., parrotfish and sea urchins). Abundances are multiplied by taxon-specific rates of carbonate alteration to determine if a reef is in a state of net accretion (habitat growth) or net loss (habitat loss; Fig. 4). At Brewers Bay, six transects were surveyed in 2017 and 2023 to obtain carbonate budgets. These data show stable carbonate production over the monitoring time points. The transect results showed positive carbonate budgets in 2017 and 2023, which implies that this site supported reef accretion over the past eight years. However, carbonate production significantly declined from 5.08 ± 1.78 sd kg m^{-2} yr^{-1} in 2017 to 1.33 ± 1.78sd kg m^{-2} yr^{-1}. This change was mainly driven by a reduction in coral production from 6.90 ± 2.13 in 2017 to 1.98 ± 0.326 in 2023.

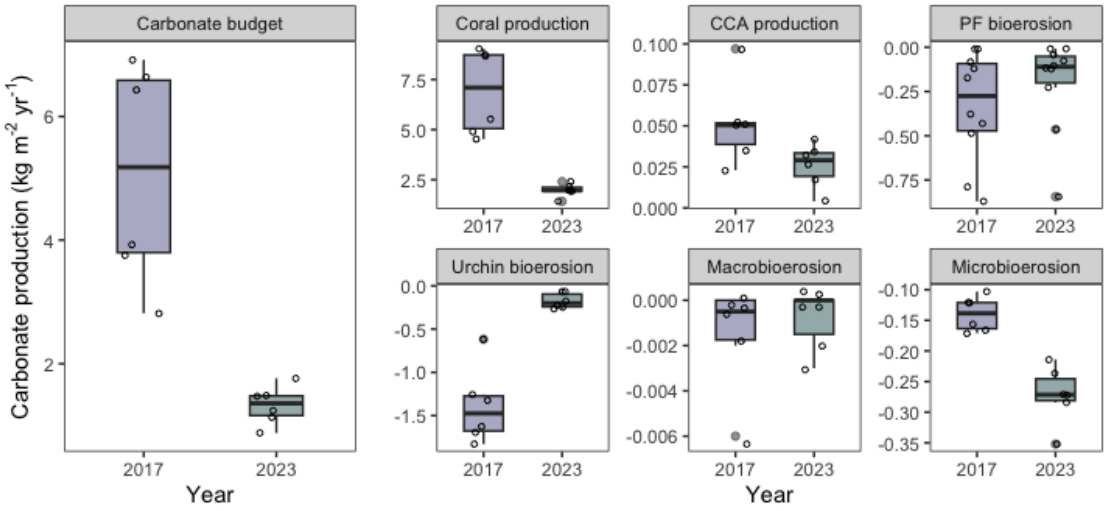

Figure 4: *Net carbonate production and the magnitude of carbonate alteration by calcifying or bioeroding functional groups. CCA represents crustose coralline algae. PF represents parrotfish. The scale of the y-axis varies for each functional group.*

Calcification Accretion Units (CAUs) and **Bioerosion Monitoring Units (BMUs)** were used to investigate the balance between calcification and erosion. CAUs and BMUs were collected and redeployed for the next sampling cycle. CAUs are processed by the NCRMP Pacific Climate group and the data will be available within a year. BMUs will be dried and cleaned using a hydrogen peroxide solution. Samples will be weighed and scanned using a CT scanner and then compared to their pre-scans to quantify bioerosion.

Landscape mosaics are used to quantify the benthic community, and to monitor changes in coral cover over time. Thousands of underwater images are digitally stitched together to create a high-resolution archive of the reef at the time of collection.

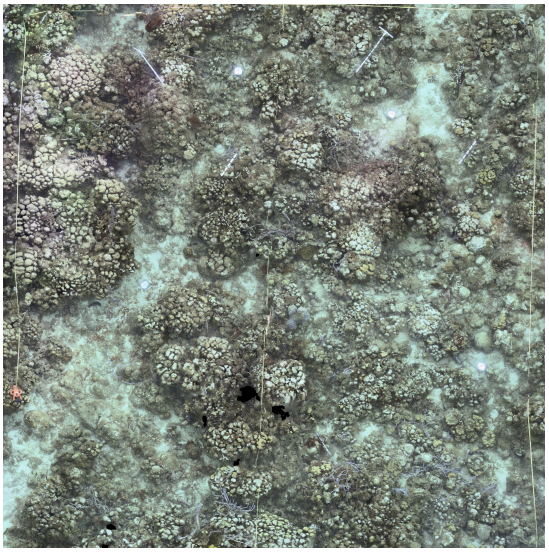

Figure 5: *Landscape Mosaic collected from transect 1 at Brewer's Bay in St. Thomas*

About the monitoring program

AOML's climate monitoring is a key part of the National Coral Reef Monitoring Program of NOAA's Coral Reef Conservation Program (CRCP), providing integrated, consistent, and comparable data across U.S. Managed coral reef ecosystems. NCRMP monitoring efforts aim to:

- Document the status of reef species of ecological and economic importance
- Track and assess changes in reef communities in response to environmental stressors or human activities
- Deliver high–quality data, data products, and tools to the coral reef conservation community

Point of Contact

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For more information

Coral Reef Conservation Program:
http://coralreef.noaa.gov

NCRMP climate monitoring:
https://www.coris.noaa.gov/monitoring/climate.html

NOAA Atlantic Oceanographic and Meteorological Laboratory: http://www.aoml.noaa.gov/

U.S. Virgin Islands Reef Status Report 2020

National Coral Reef Status Report 2020

Acknowledgments

These efforts were jointly funded by NOAA's CRCP project #743 and OAP. We would like to sincerely thank the University of the Virgin Islands particularly Dr. Tyler Smith and his team, Sarah Heidmann, Lindsay Dade, Nicole Krampitz, Adeline Shelby and Erin Hollander for all of the mission support we received for the trip.

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