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**Water Quality Continuous Monitoring Report 2017-2019**

**Temperature**

Temperature measurement were taken using two YSI Sonde 6600 V2 (Seawater Intake and Outfall 001) with temperature sensor 6560 that has a resolution of 0.01°C and accuracy of  $\pm 0.15^\circ\text{C}$ . These parameters follow the Standard Methods for the Examination of Water and Wastewater (2012). Figure 3 show the monthly average temperature ( $^\circ\text{C}$ ) from January 2017 to December 2019. Natural fluctuation with the changes in season was observed on the 3-year period. From this record we observed that September 2019 recorded the hottest temperature reading with a monthly average of  $30.42^\circ\text{C}$ .

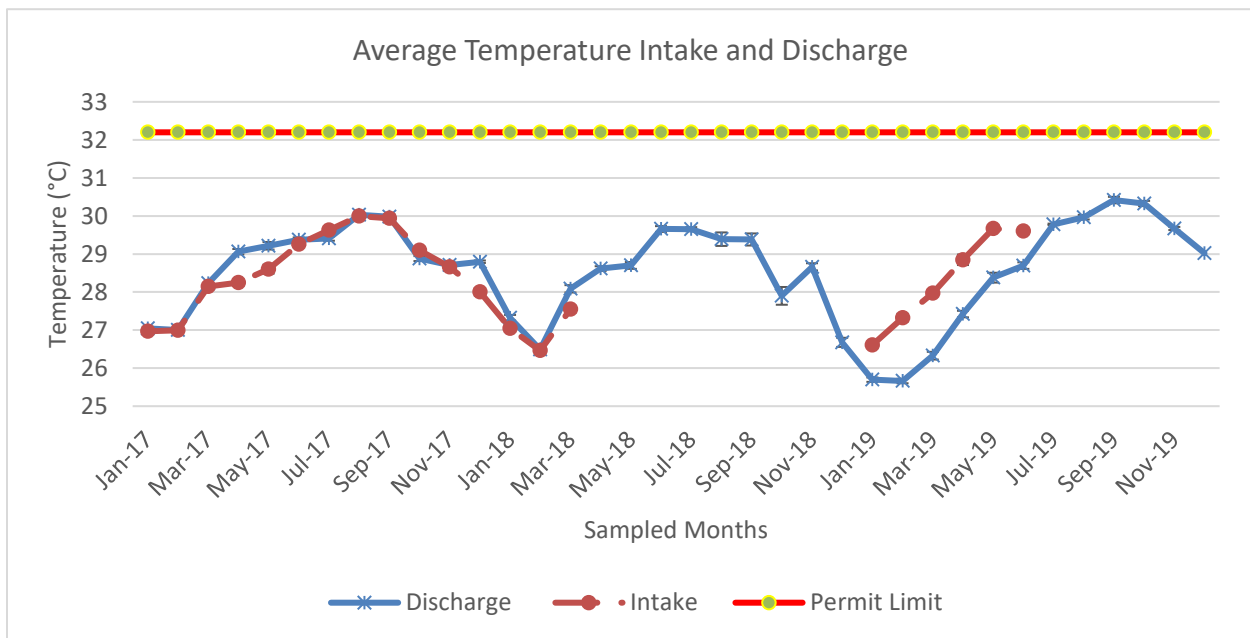


Figure 3. Comparison between Seawater Intake Sonde data and Outfall 001 Sonde (Discharge). Recorded data for the Intake is incomplete due to instrument failures.

Monthly temperature data of 2017 from the Sondes (Seawater Intake and Outfall) was compared data from CariCOOS Ponce Buoy (N17°51'36.4" W66°31'26.4") (Figure 4) result from Anova show no significant difference ( $P=0.45$ ). Incomplete data record from Seawater Intake Sonde was due to malfunction and had to be sent to repaired in mid-2018 and was returned mid-January 2019 and again malfunctioned in July 2019 and was send back to repaired. A fraction of 2017 data from the Sondes were compared to temperature data from HOBOS temperature pendant located close to Seawater

Intake (N17°58'31.4" W66°45'33.8"), Outfall (N17°58'23.9" W66°45'39.9") and Egorov (N17°57'41.3" W66°46'00.6") (Figure #) data was supply by HJReefScaping. Comparison using a non-parametric approach (Kruskal-Wallis) of daily temperature average from the end of August 2017 to January 2018 resulted no significant difference(P=0.123) (Figure 5). Egorov is located 0.82 nautical mile south of the location of the Outfall 001 Sonde and 1.02 nautical mile from the Seawater Intake Sonde and no significant difference was observed. The observe temperature pattern from the Sondes follows the pattern observed by the CariCOOS Buoys. Monthly average data from the Outfall 001 was compared to CariCOOS Buoys for the tree year period. The result of the F-test indicated no significant difference (P=0.122)(Figure 6). CariCOOS Ponce Buoy is located 15 nautical miles toward the East of the Outfall 001; and 7 nautical miles from La Guancha in Ponce. This result indicates that the temperatures data logged by the Sonde in the Outfall 001 during the period show no signal of thermal pollution from the discharged water due to EcoElectrica Operation.

#### ANOVA: Single Factor 2017 Data

##### SUMMARY

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
CariCOOS Buoy				
Ponce	11	311.0665	28.27877	1.099264
Discharge	12	345.7407	28.81172	0.953066
Intake	12	343.536	28.628	1.036677

##### ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	1.670048618	2	0.835024	0.81268	0.452615	3.294537
Within Groups	32.87981815	32	1.027494			
Total	34.54986677	34				

Figure 4. The result of the ANOVA comparing 2017 monthly average temperature show no significant difference (P=0.45).

During the 36 months sampling period, the temperature did not exceed the 32.2°C that is stablish by the PREQB Water Quality Standards as of 2014. The higher temperature recorded on 2019 correspond to a temperature anomaly of >0.5°C annual mean value discussed in Cheng et al. (2020). Cheng et al. (2020) discuss that the Ocean Heat Content (OHC) has increased over the last 5 years and that 2019 was the highest OHC ever recorded. Temperatures above 30°C are more recurrent that before. Winter et al. (1998) show recorded temperature data of La Parguera from 1966 to 1995 temperatures above 30°C was sustained for more than 30 days in 1990 and temperatures >31°C was sustained for 8 days 1995. This high temperature events were abnormal but on the last 5 years these events have been seen more frequently (Cheng et al. 2020, Cheng and Zhu 2018).

Kruskal-Wallis

One Way Analysis of Variance on Ranks

<i>Group</i>	<i>N</i>	<i>Missing</i>	<i>Median</i>	<i>25%</i>	<i>75%</i>
Sonde Intake	112	0	28.419	27.47	29.052
Sonde Outfall	112	0	28.584	27.701	29.173
Intake Hobo	112	0	28.678	27.709	29.327
Outfall Hobo	112	0	28.738	27.828	29.364
Egorov Hobo	112	0	28.69	27.912	29.172

H = 7.265 with 4 degrees of freedom. (P = 0.123)

Figure 5. The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.123)

F-Test Two-Sample for Variances

	<i>Discharge</i>	<i>CariCOOS Buoy Ponce</i>
Mean	28.5459	28.28555311
Variance	1.699627	1.116591179
Observations	36	31
df	35	30
F	1.522157	
P(F<=f) one-tail	0.121955	
F Critical one-tail	1.813173	

Figure 6. Comparison between Sonde of the Outfall 001 and CariCOOS Buoy Ponce data. F Critical value is higher than the calculated F value thus we cannot assume difference between the data.