City of Sanibel Clean Canals Program

Year One Monitoring Report

SCCF
Sanibel-Captiva Conservation Foundation
Marine Laboratory

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Submitted by:

Mark Thompson, M.S., Research Associate

Eric Milbrandt, Ph.D., Director

900A Tarpon Bay Rd, Sanibel, FL 33957

Description of the Project

Prior to the incorporation of the City of Sanibel, canals were dug to provide water access and fill for residential developments. Due to the design and location of man-made canals on Sanibel Island it is likely that these areas to experience dense algae blooms, low oxygen concentrations and fish kills. The low flow and minimal flushing conditions seen in canals increases water residence times and can promote the formation of phytoplankton blooms. Algae blooms in southwest Florida can be a health concern for humans and wildlife, and is also perceived as an aesthetic problem for residential communities located on canals. These conditions may also impact property values (Florida Realtors Report 2015). Factors such as rainfall, tides, stormwater and irrigation runoff and freshwater releases from the Caloosahatchee River system can be the primary cause of poor water quality within canals. Groundwater quality and flow may also affect the conditions found in canals. A more thorough knowledge of the spatial and temporal variability in canal water quality can benefit management decisions aimed at improving water quality.

The Sanibel Communities for Clean Water initiative was created to provide water quality data and recommendations to homeowners surrounding ponds and lakes (mainly freshwater systems) on the island’s interior. This program was extended to include homeowners located on canals to support the initiative. However, these data are not directly comparable to freshwater bodies and have different water quality criteria under the Florida Department of Environmental Protection (DEP). This report summarizes the results of wet (August 2019) and dry season (March 2020) sampling at approximately 35 sites within Sanibel’s canal systems.

Methods

Surface water samples were taken at 35 individual sites chosen by the City of Sanibel Department of Natural Resources staff (Figure 1). Samples were collected from each site once during wet season and once during dry season. Sampling was conducted in two trips each season with 15-20 sites sampled per trip. Each sampling event was conducted within 48 hours of a rainfall event of 0.2 inches or greater. Wet season samples were collected in August 2020 during the annual fertilizer ban period. Samples were analyzed by Benchmark Laboratories for orthophosphate (OP), total phosphate (TP), nitrate-nitrite (NOx), ammonia (NH3), and total nitrogen (TN). A calibrated YSI data sonde was deployed at each site to measure dissolved oxygen (DO), turbidity, colored dissolved organic matter (CDOM), chlorophyll *a*, pH, salinity and temperature in the field. Results were entered into the SCCF Water Quality Database and will be uploaded into the DEP central water quality data storage system, Watershed Information Network (WIN) to allow evaluation under the State of Florida’s impaired waters rule.

Nonparametric statistics (Minitab® 13) were used to compare water quality in canals from four different regions of Sanibel – Dinkins Bayou, Caloosahatchee Shores, Northern

Sanibel and Eastern Sanibel. Wet season water quality was also compared to dry season and canals bordered by mangroves were compared to those with seawalls.

The 35 sampling sites were ranked from most impaired to least impaired water quality based upon results of chlorophyll a, total phosphorus, inorganic nitrogen, and turbidity similar to the Sanibel Communities for Clean Water (SCCW) Program. However, this set of ranking parameters are slightly different from the SCCW Program (Trophic State Index values are only calculated for freshwater bodies) and were chosen because they are indicators of eutrophication in salt and brackish waterbodies (J. Burkholder NC State, powerpoint presentation SFWMD 2019). Each parameter was equally weighted except for turbidity which was weighted at 50% -- it is a common issue in canals and is often tied to Chl-a concentrations. The values for each parameter were ranked from 1 to 35 with 1 being the highest value (most impaired water quality) and 35 being the lowest (least impaired water quality). After ranking for each parameter, the ranked values were added and the sum of ranks was then ordered for overall site rank (lowest sum rank = most impaired water quality rank). This exercise allows an overall comparison between sites. Chlorophyll *a*, total nitrogen and total phosphorus results were also compared to Florida state water quality criteria to further characterize current conditions in the canals.

The results of water quality monitoring are provided in an excel workbook containing raw data, and comparison analyses. This spreadsheet will be the source of data for updating the Communities for Clean Water interactive website. A webpage for the Clean Canals Program is being developed to provide information on canal water quality and Best Management Practices (BMPs) for canal-front communities. The BMPs will provide homeowners guidance on how to protect and improve water quality.

Results

Sampling data were compared to the DEP Pine Island Sound criteria to provide an estimation of impairment within each canal. Of the 35 sites sampled, 14 sites (40%) had mean chlorophyll *a* concentrations above the 6.5 ug/l criteria. A total of 34 sites (97%) had mean TN concentrations greater than the 0.57 mg/l criteria. A total of 7 sites (20%) had mean TP concentrations greater than the 0.06 mg/l criteria (Figures 4,5,6).

When comparing chlorophyll *a* and total phosphorus concentrations between the four canal regions on Sanibel, the Dinkins Bayou canals were found to have significantly higher concentrations compared to the other regions (Figure 7). No significant difference was found between mean inorganic nitrogen concentrations or total nitrogen for canal regions (Figure 8). The mean orthophosphate concentration of eastern canals was significantly greater than the other canal regions (Figure 9). No significant difference was found for dissolved oxygen or turbidity between canal regions (Figure 10 and 11).

Mangrove canals were found to be significantly greater in chlorophyll a and total phosphorus and have significantly lower dissolved oxygen than seawall-bordered canals (Figures 12-14). No significant difference in inorganic nitrogen, turbidity and orthophosphate was found between canal types (Figures 15-17).

When comparing mean concentrations between wet and dry season for the pooled data, significantly greater total nitrogen, inorganic nitrogen, and orthophosphate was found for the wet season (Figures 18-20). Dissolved oxygen was also significantly lower in wet season (Figure 21). No significant differences were found between wet and dry season for chlorophyll *a*, total phosphorus and turbidity (Figures 22-24).

Ranking sites as described in the methods section above resulted in six canal sites which were identified as having the poorest water quality; sites 31, 35, 06, 33, 34, and 32 (Table 1). Five of those six sites were located in the Dinkins Bayou region.

Conclusions

Based upon comparison to Florida DEP water quality criteria, most of Sanibel's canals are impaired waterbodies and may not support a natural, diverse flora and fauna. Total nitrogen concentrations do not meet water quality criteria in all but one canal sampled. The main source of nitrogen from Sanibel has been previously determined to be natural land; however fertilizer and reclaimed water use for landscape irrigation are also major contributors (Thompson et al, 2018). The significantly greater nitrogen in the wet season suggests stormwater runoff may be a large contributing factor. The stormwater runoff influence is a combination of local sources and regional freshwater discharges from the Caloosahatchee River watershed (USGS 2015).

The significantly greater chlorophyll *a* values in the Dinkins Bayou canals suggest the canals in that region are more poorly flushed compared to canals in the other regions. Quiescent conditions are beneficial for phytoplankton and algae production. In addition to poor flushing, the Dinkins Bayous canals are in close proximity to a golf course and a decommissioned wastewater package plant, and are also surrounded by residential development. Therefore, the canals in this region are likely influenced by these land use classes, which tend to have high nutrient concentrations in surface water runoff and groundwater. Five of the six canals with the poorest water quality were in the Dinkins Bayou region.

The eastern canals had significantly greater orthophosphate concentrations. Irrigation with reclaimed wastewater has been previously linked to greater orthophosphate concentrations in stormwater runoff, lakes and groundwater on Sanibel. The eastern canals drain the watershed (the area of island east of Beach Road and the Eastern Basin of the Sanibel Slough when it discharges) with the greatest reclaimed water usage (with golf course) and the Sanibel Slough periodically discharges into these canals.

Lower dissolved oxygen (DO) levels in the wet season compared to the dry season are typical due to increased water temperature and increased abundance of phytoplankton. Canals in all regions had similar DO characteristics, lower DO in the morning hours and increasing as the day went on. The time of day in which sampling took place had a great influence in what the DO value would be at the site.

Comparing canals bordered by mangroves verses those with seawalls found generally poorer water quality in the mangrove canals. Most of the mangrove canals were located in areas with poorer flushing (considers influence of tidal exchange, surface water runoff, and groundwater flows), farther upstream from the inlet (the point at which the canal system connects to the estuary) and had poor tidal exchange (influence of tides only). The other factors influencing water quality in Sanibel's canals are likely more significant than the immediate shoreline type (e.g. land use class, soil types, groundwater, etc.). Most of the canals were in areas with similar development except for proximity of golf courses.

In general Sanibel's canals have poor flushing and water quality impairments typical of estuarine canals throughout developed areas of Florida. Water quality conditions are greatly influenced by the amount of flushing the canal receives and land use in the watershed, On Sanibel, the proximity to golf course runoff and groundwater flow have been shown to have significant impacts on water quality as well as regional freshwater flows from the Caloosahatchee watersheds.

Attachment: Excel spreadsheet: Sanibel_Clean_Canals_2020

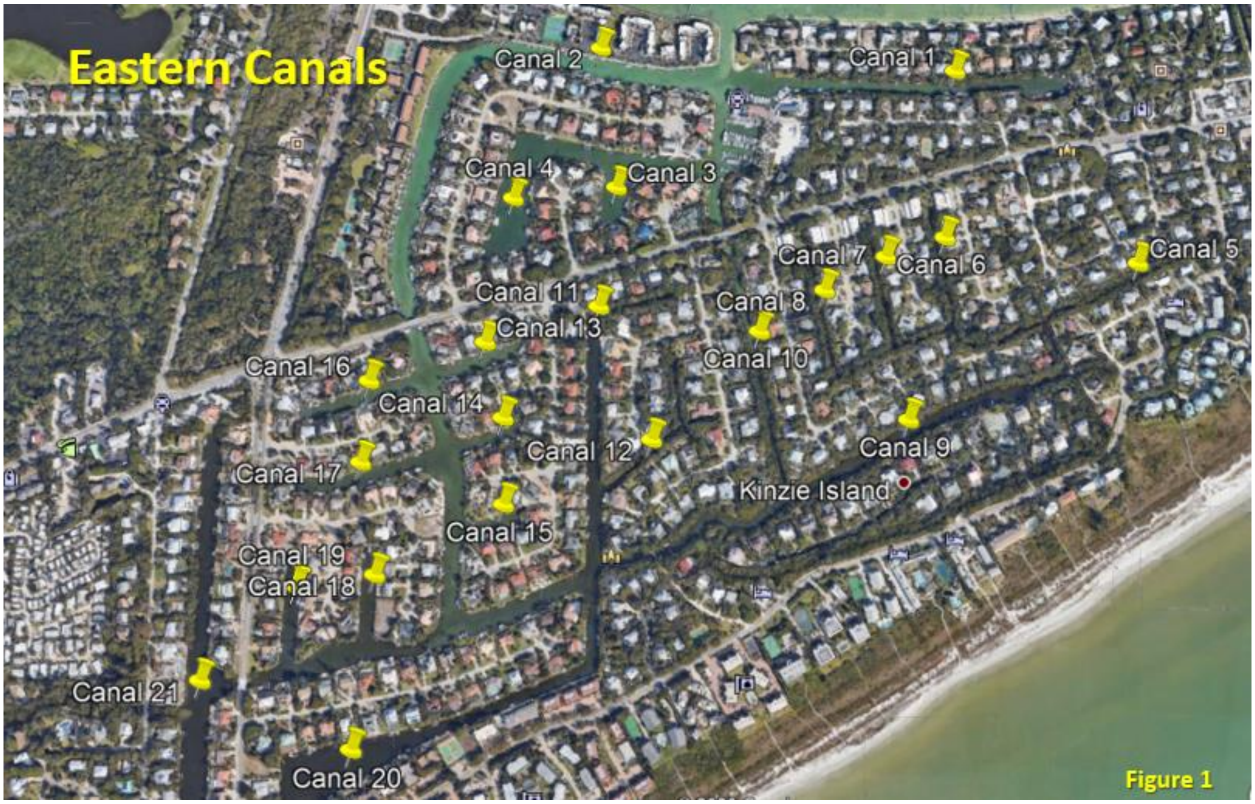

Figure 1

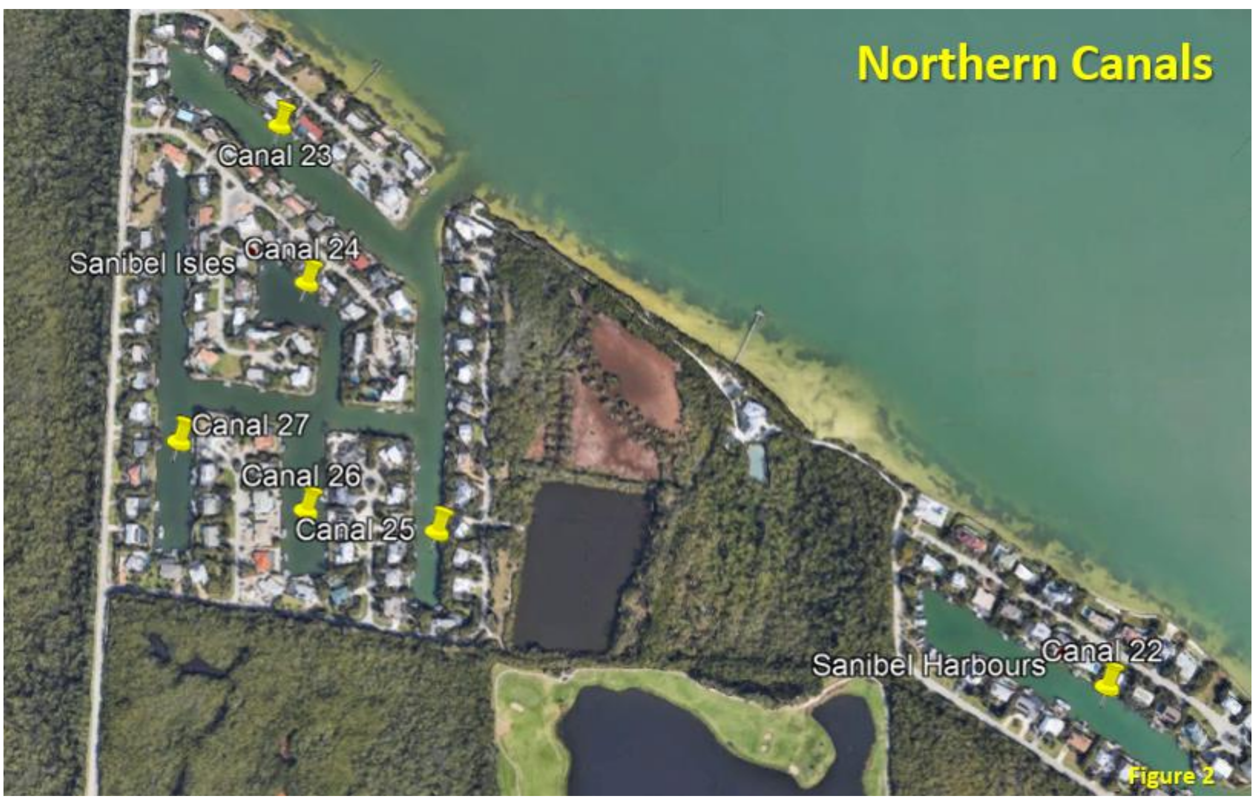

Figure 2

Figures 1-3. Location of sampling sites for collection of water quality data from Sanibel's canals.

Table 1. Data used to rank the 35 canal sites tested during this project. Sites are listed by water quality rank from worst (rank1) to best (rank35).

Site	Lat	Long	Rank	IN_Mean	TP_Mean	Chla_Mean	Turb_Mean	INRank	TPRank	ChlaRank	TurbRank	SumRank	TN	DO
SCC31	26.45126	-82.028	1	0.29124	0.083	35.7	3.3	1	1	1	27	16.5	0.825	4.2
SCC35	26.45162	-82.0334	2	0.09548	0.068	25.85	6.9	8	4	3	9	19.5	0.655	3.05
SCC06	26.44964	-82.0332	3	0.06363	0.081	34.1	19.4	16	2	2	1	20.5	1.05	1.05
SCC33	26.44947	-82.0348	4	0.1365	0.058	14.6	11.35	7	8	6	4	23	0.835	3.9
SCC34	26.44859	-82.0251	5	0.16449	0.0625	19.3	4.95	4	7	5	18	25	0.725	4.2
SCC32	26.44892	-82.0282	6	0.27578	0.0515	9.55	6.1	2	11	8	15	28.5	0.58	3.85
SCC07	26.44862	-82.0291	7	0.05095	0.0685	13.9	4.5	21	3	7	22	42	0.765	1.1
SCC21	26.44818	-82.03	8	0.05446	0.05	6.8	6.8	19	14	14	10	52	0.745	5.8
SCC15	26.44761	-82.031	9	0.04879	0.0505	6.4	10.3	22	12	16	5	52.5	0.835	5.4
SCC05	26.44639	-82.0288	10	0.01344	0.0665	25.8	4.8	33	6	4	19	52.5	0.865	1.15
SCC18	26.44795	-82.0334	11	0.09053	0.041	5.15	13.2	9	21	22	3	53.5	0.665	5.95
SCC01	26.44613	-82.0326	12	0.04735	0.0435	7.2	7.05	24	18	13	8	59	0.61	4.7
SCC08	26.44745	-82.0352	13	0.03114	0.068	5.5	9.55	30	5	21	7	59.5	1.09	1.05
SCC29	26.44645	-82.0349	14	0.07986	0.053	4.85	3.7	12	10	25	26	60	0.825	3.65
SCC20	26.44526	-82.0348	15	0.02192	0.0505	9.05	6.45	31	13	9	14	60	0.775	5.3
SCC24	26.44696	-82.0369	16	0.06436	0.0485	5.85	2.85	15	16	18	29	63.5	0.725	4.8
SCC28	26.44584	-82.037	17	0.03185	0.0545	6.5	3.75	29	9	15	25	65.5	0.85	4.1
SCC09	26.44435	-82.0367	18	0.04458	0.05	7.3	2.95	25	15	12	28	66	0.68	2.75
SCC16	26.44424	-82.0378	19	0.0106	0.048	8.35	6.65	34	17	10	11	66.5	0.74	5.65
SCC19	26.44211	-82.037	20	0.06643	0.0425	4.3	5.1	14	19	26	17	67.5	0.545	5.75
SCC11	26.44302	-82.0392	21	0.04034	0.042	7.4	3.95	26	20	11	24	69	0.81	3.85
SCC27	26.46023	-82.0461	22	0.1379	0.0345	5.55	2.4	6	31	20	32	73	0.595	5.2
SCC12	26.46555	-82.0548	23	0.06007	0.0395	5.55	2.5	17	23	19	31	74.5	0.78	3.95
SCC17	26.46163	-82.053	24	0.0806	0.035	2.65	10.05	11	30	31	6	75	0.655	6.65
SCC30	26.4641	-82.0543	25	0.04809	0.041	5.05	6.6	23	22	24	12	75	0.995	3.45
SCC13	26.46176	-82.0541	26	0.06787	0.0375	2.65	6.6	13	26	30	13	75.5	0.63	5.25
SCC10	26.47994	-82.1774	27	0.1545	0.0355	2.55	4.65	5	29	32	20	76	0.695	3.6
SCC23	26.46246	-82.0555	28	0.20761	0.0295	3	4.2	3	34	29	23	77.5	0.72	5.1
SCC25	26.47373	-82.1543	29	0.0814	0.036	2.4	4.65	10	28	34	21	82.5	1.035	5.25
SCC26	26.47269	-82.1538	30	0.03256	0.0335	5.1	18.8	28	33	23	2	85	0.685	4.8
SCC03	26.47163	-82.1543	31	0.05724	0.0335	3.7	5.5	18	32	28	16	86	0.73	5.5
SCC22	26.47449	-82.1687	32	0.02192	0.0395	6.2	2.2	32	24	17	33	89.5	0.67	5.9
SCC04	26.47894	-82.1758	33	0.05301	0.028	3.9	2	20	35	27	34	99	0.605	5.55
SCC02	26.48041	-82.1762	34	0.0388	0.039	2.3	1.8	27	25	35	35	104.5	0.66	5.45
SCC14	26.48071	-82.1786	35	0.00778	0.0365	2.4	2.8	35	27	33	30	110	0.86	5.15

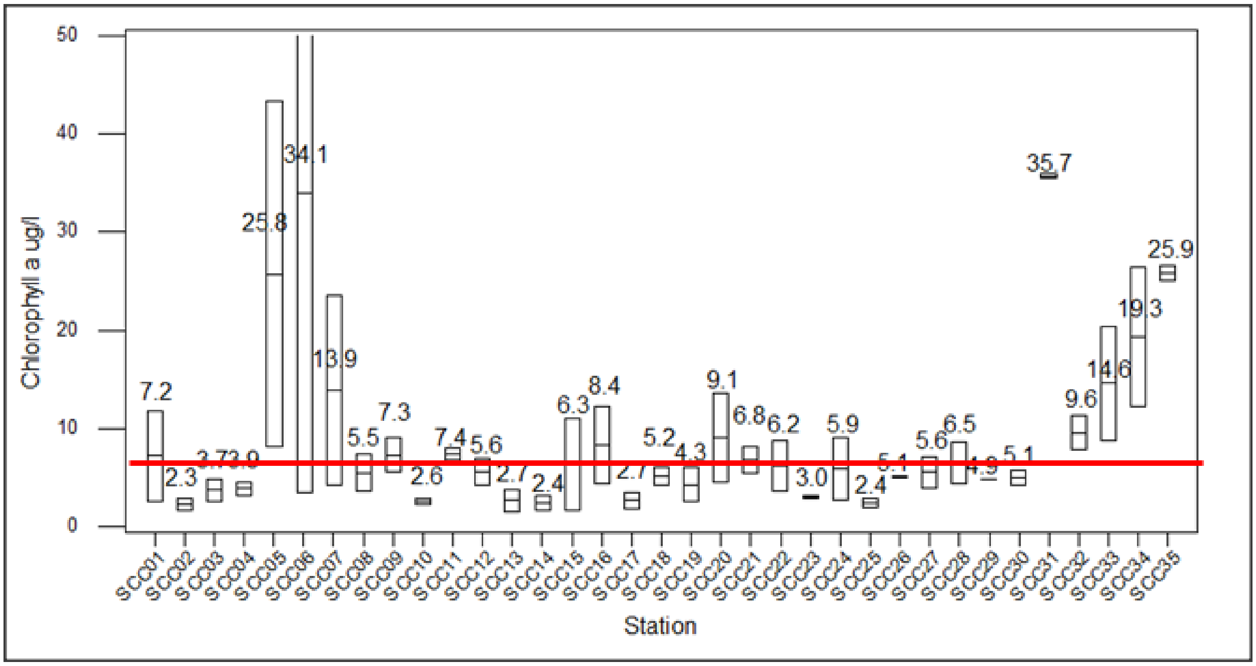

Figure 4. Mean chlorophyll *a* ug/l concentrations for the 35 sites sampled during this project. The mean is derived from one wet season and one dry season sample. The red line indicates the value to water quality criteria for this parameter.

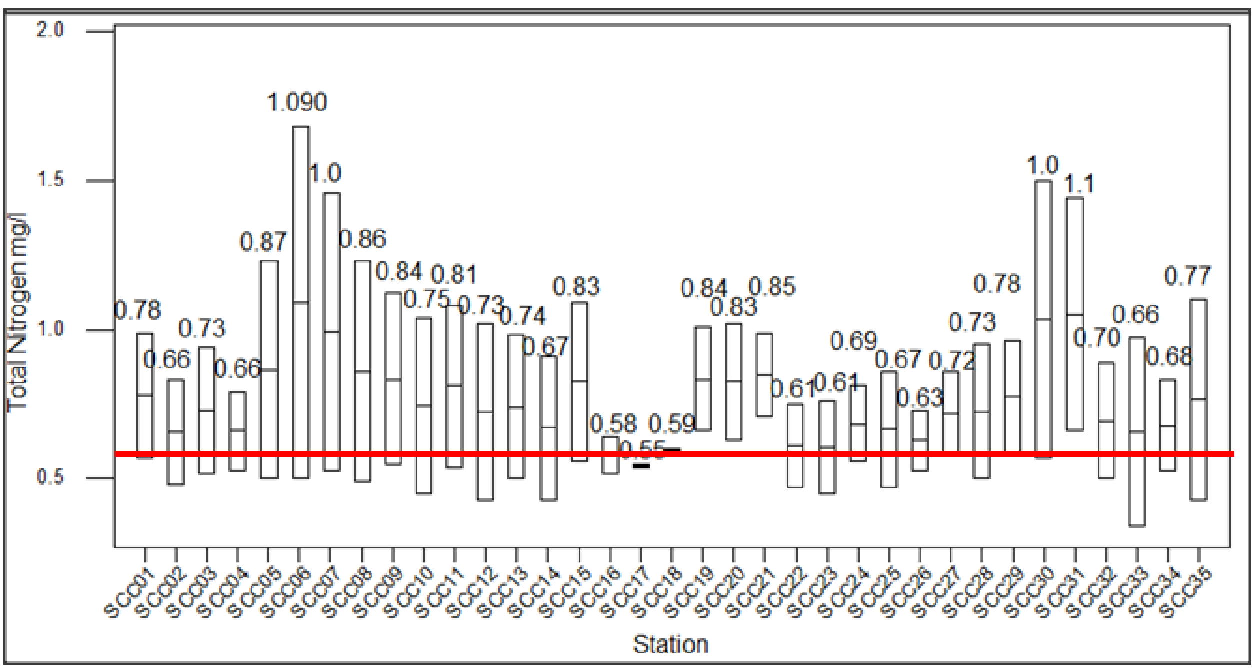

Figure 5. Mean total nitrogen (mg/l) concentrations for the 35 sites sampled during this project. The mean is derived from one wet season and one dry season sample. The red line indicates the value to water quality criteria for this parameter.

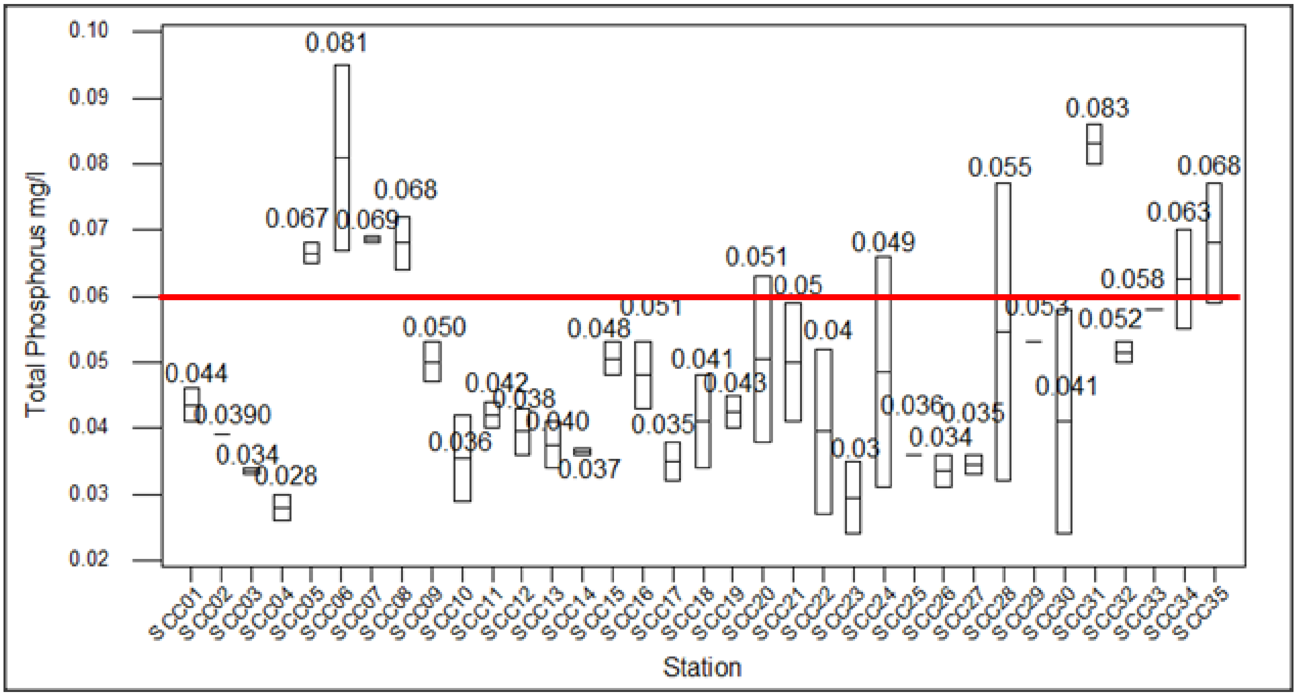

Figure 6. Mean total phosphorus (mg/l) concentrations for the 35 sites sampled during this project. The mean is derived from one wet season and one dry season sample. The red line indicates the value to water quality criteria for this parameter.

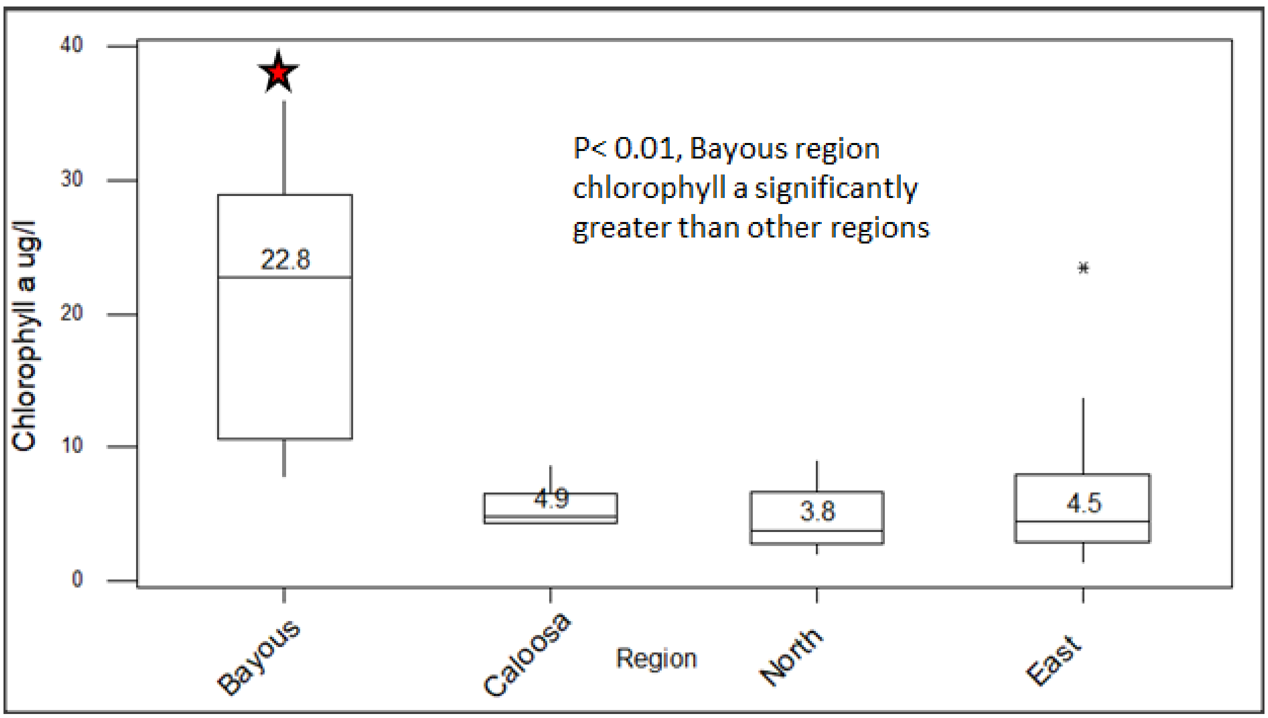

Figure 7. Mean chlorophyll *a* concentrations for the four different canal regions sampled during this project. Red star indicates significant greater concentration in Bayous region. Kruskal-Wallis nonparametric test.

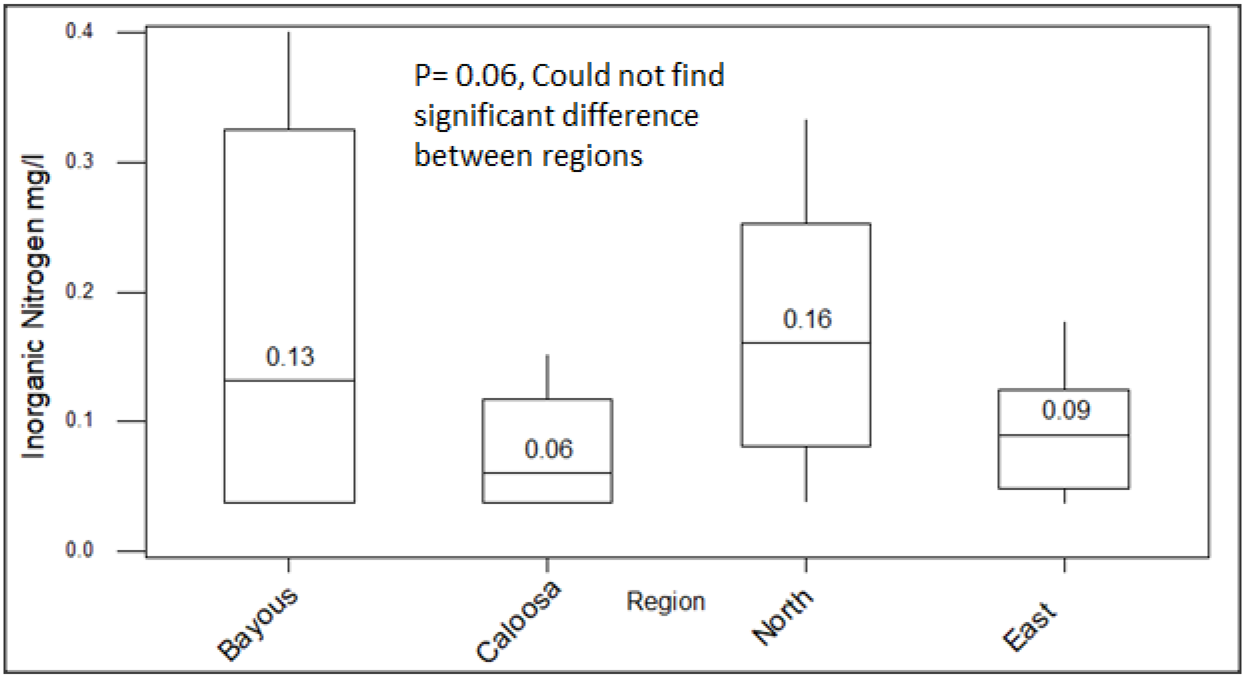

Figure 8. Mean inorganic nitrogen (mg/l) concentrations for the four different canal regions sampled during this project. No significant difference could be found between regions. Kruskal-Wallis nonparametric test.

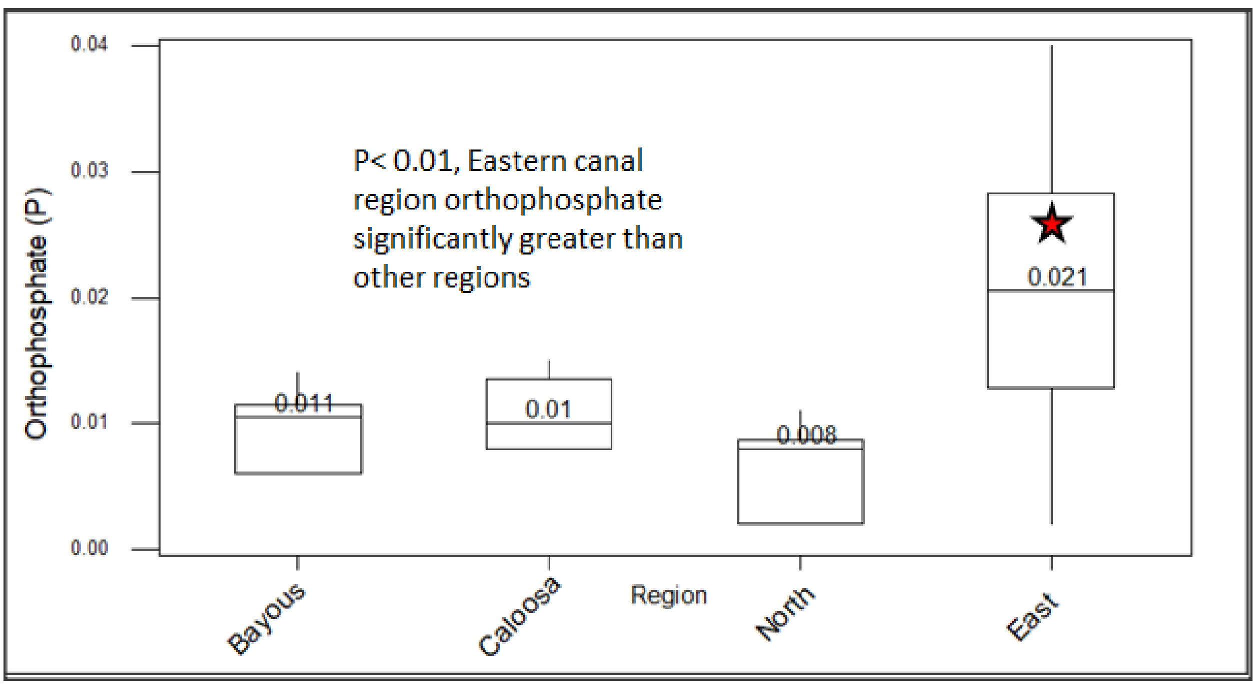

Figure 9. Mean orthophosphate concentrations (mg/l) for the four different canal regions sampled during this project. Red star indicates significant greater concentration in East region. Kruskal-Wallis nonparametric test.

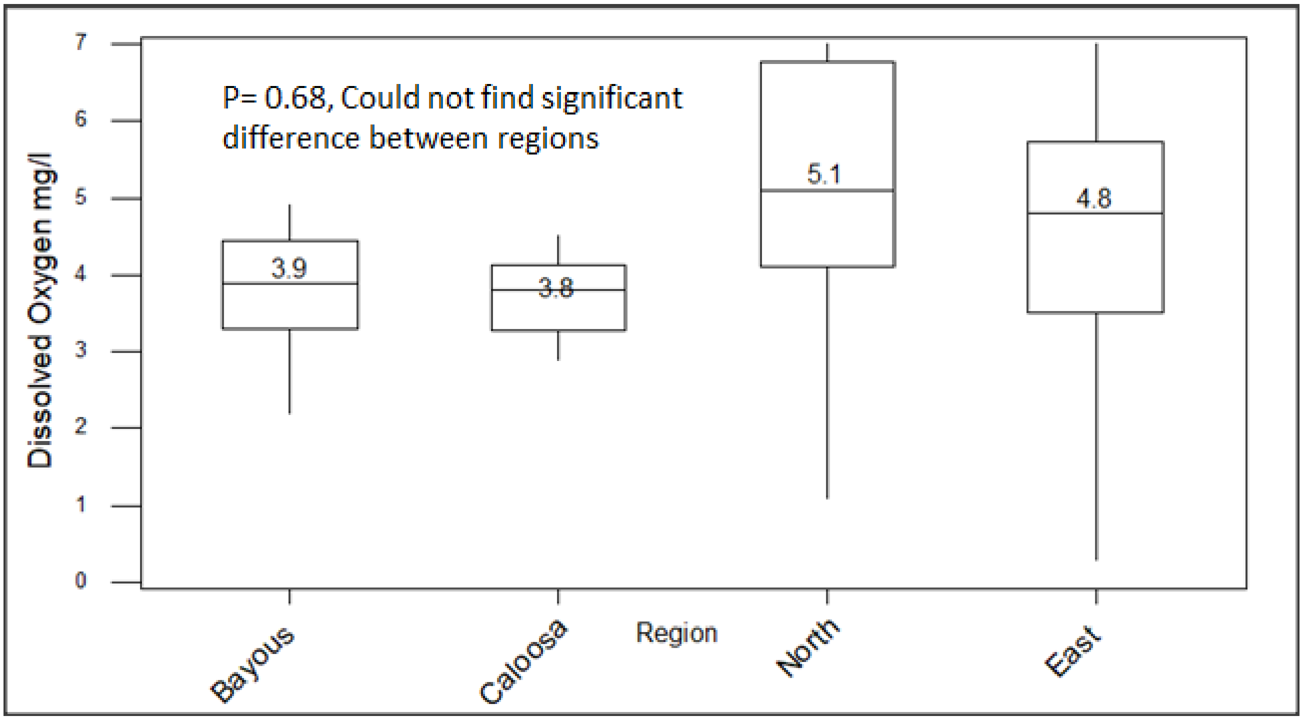

Figure 10. Mean dissolved oxygen (mg/l) concentrations for the four different canal regions sampled during this project. No significant difference could be found between regions. Kruskal-Wallis nonparametric test.

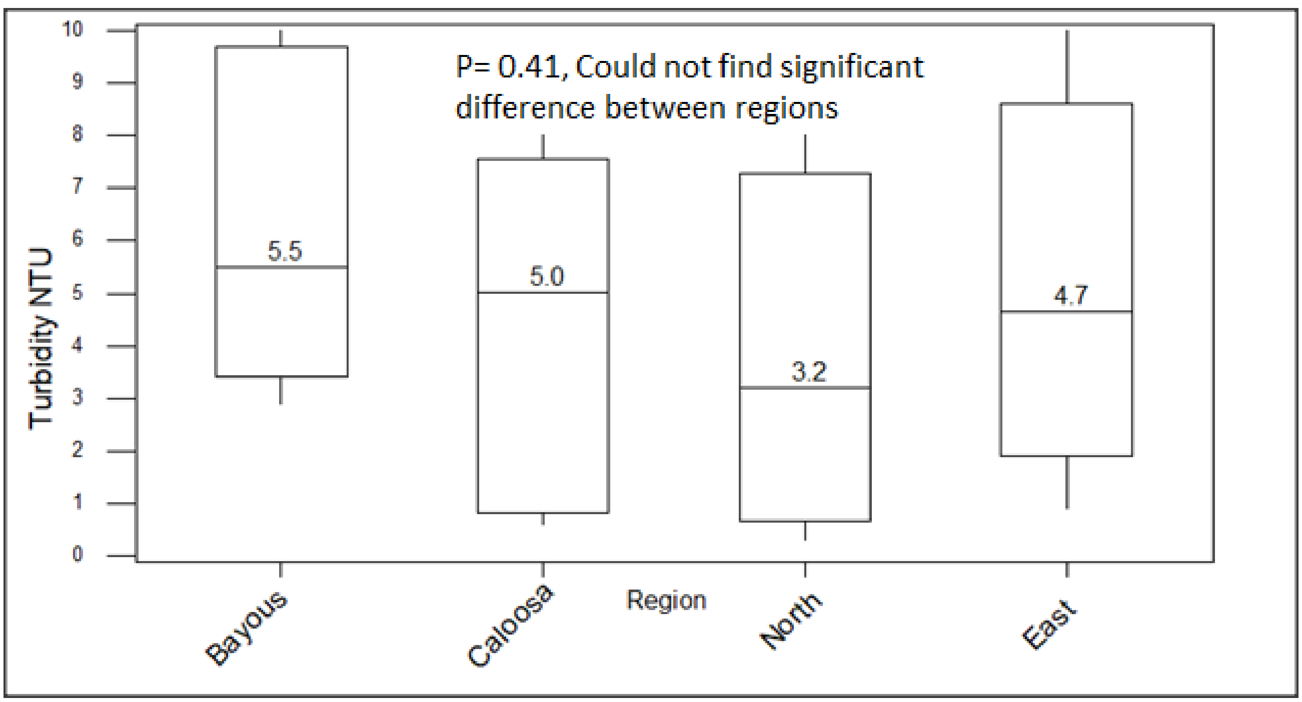

Figure 11. Mean dissolved oxygen (mg/l) concentrations for the four different canal regions sampled during this project. No significant difference could be found between regions. Kruskal-Wallis nonparametric test.

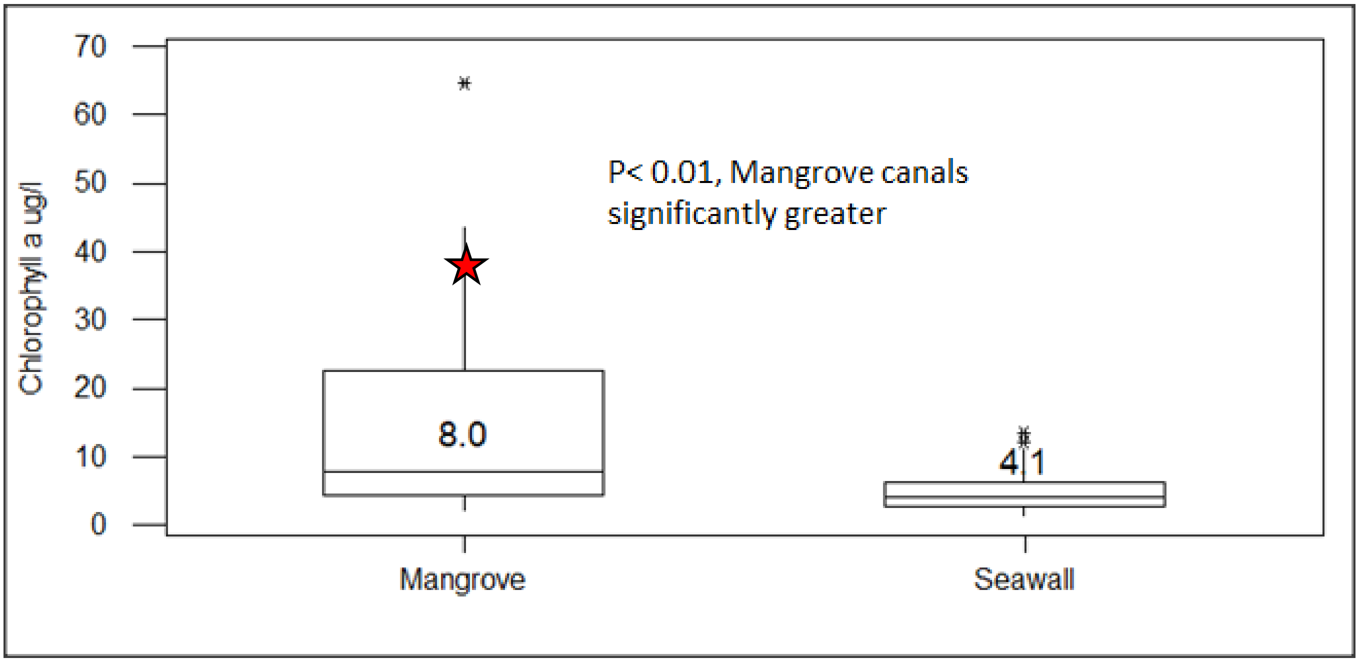

Figure 12. Mean chlorophyll *a* concentration for canals bordered by mangroves compared to those bordered by seawall. Significantly greater chlorophyll *a* found in mangrove canals. Kruskal-Wallis test.

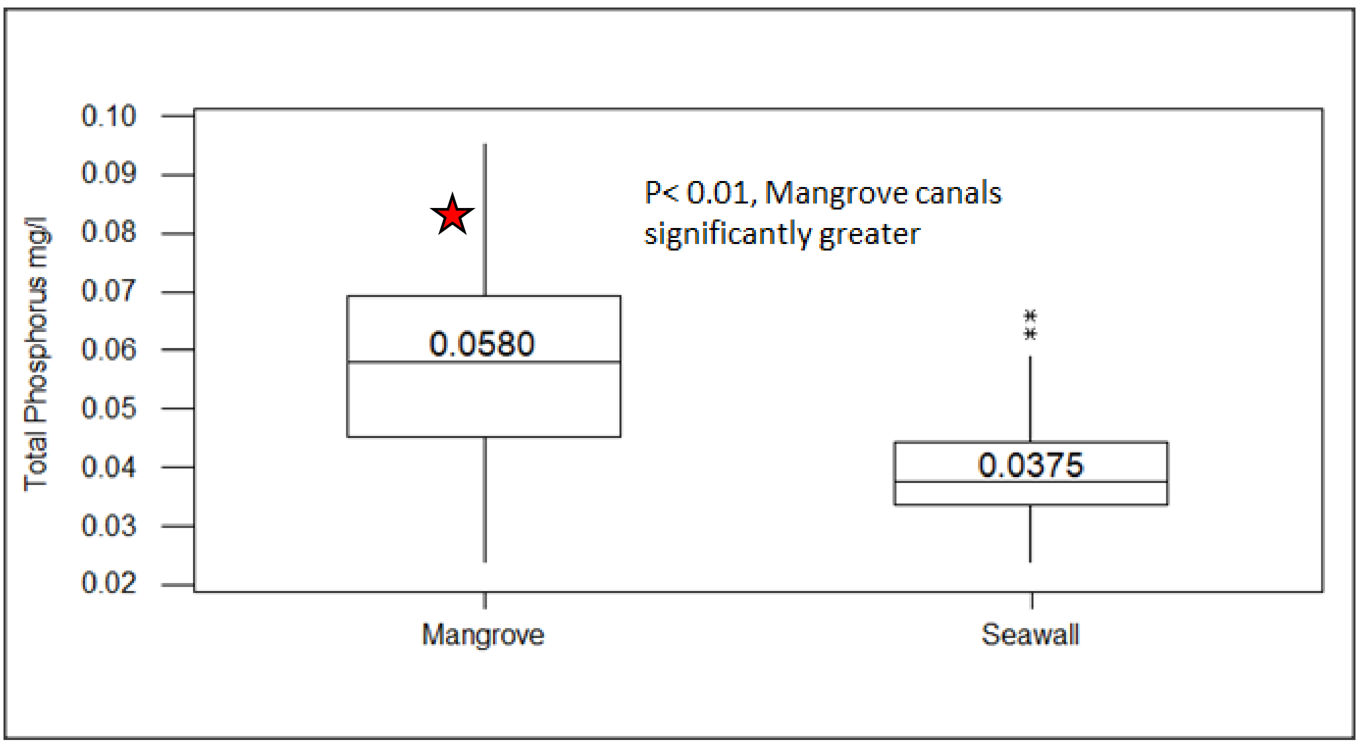

Figure 13. Total phosphorus concentration for canals bordered by mangroves compared to those bordered by seawall. Significantly greater phosphorus found in mangrove canals. Kruskal-Wallis test.

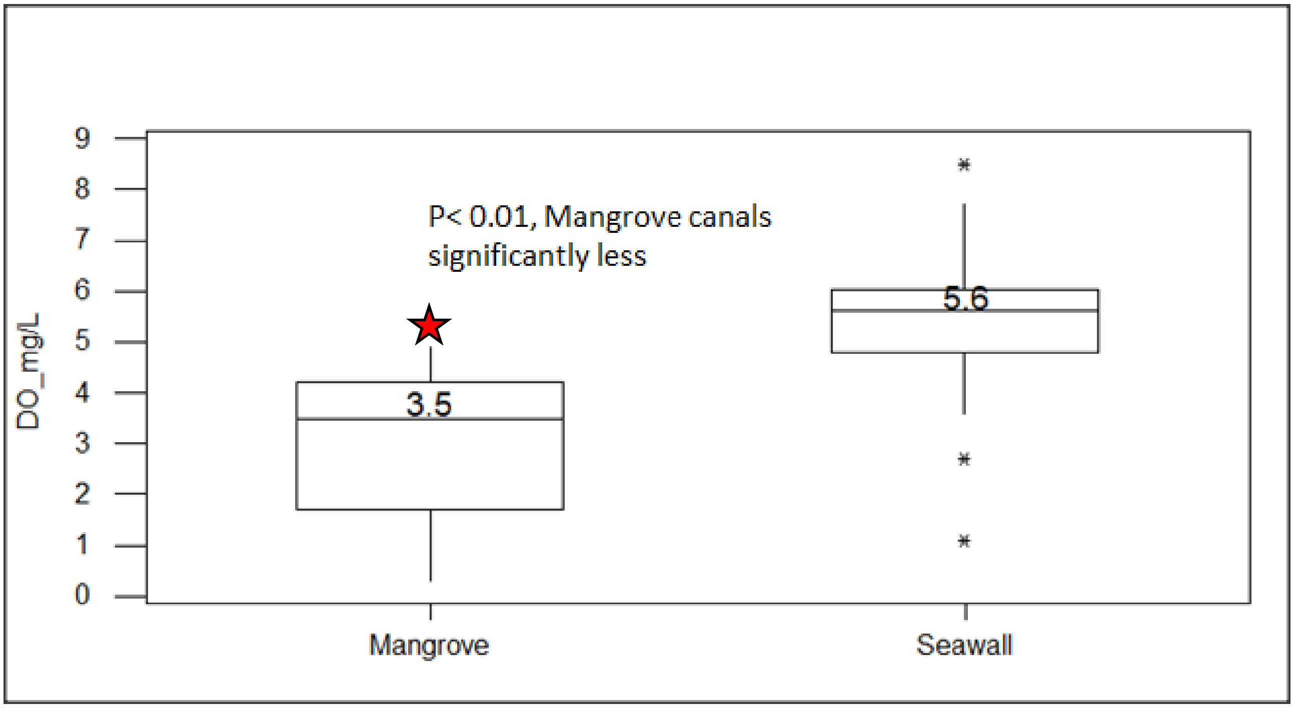

Figure 14. Mean dissolved oxygen concentration for canals bordered by mangroves compared to those bordered by seawall. Significantly less DO found in mangrove canals. Kruskal-Wallis test.

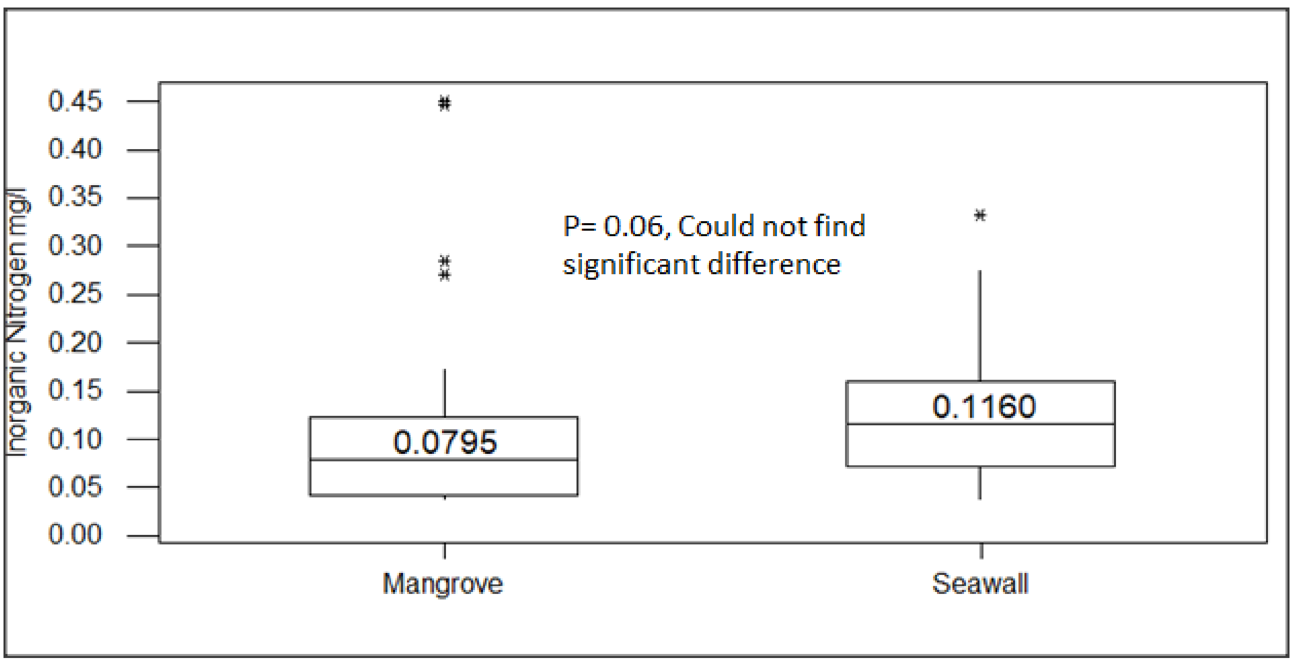

Figure 15. Mean inorganic nitrogen concentration for canals bordered by mangroves compared to those bordered by seawall. No significant difference could be found. Kruskal-Wallis test.

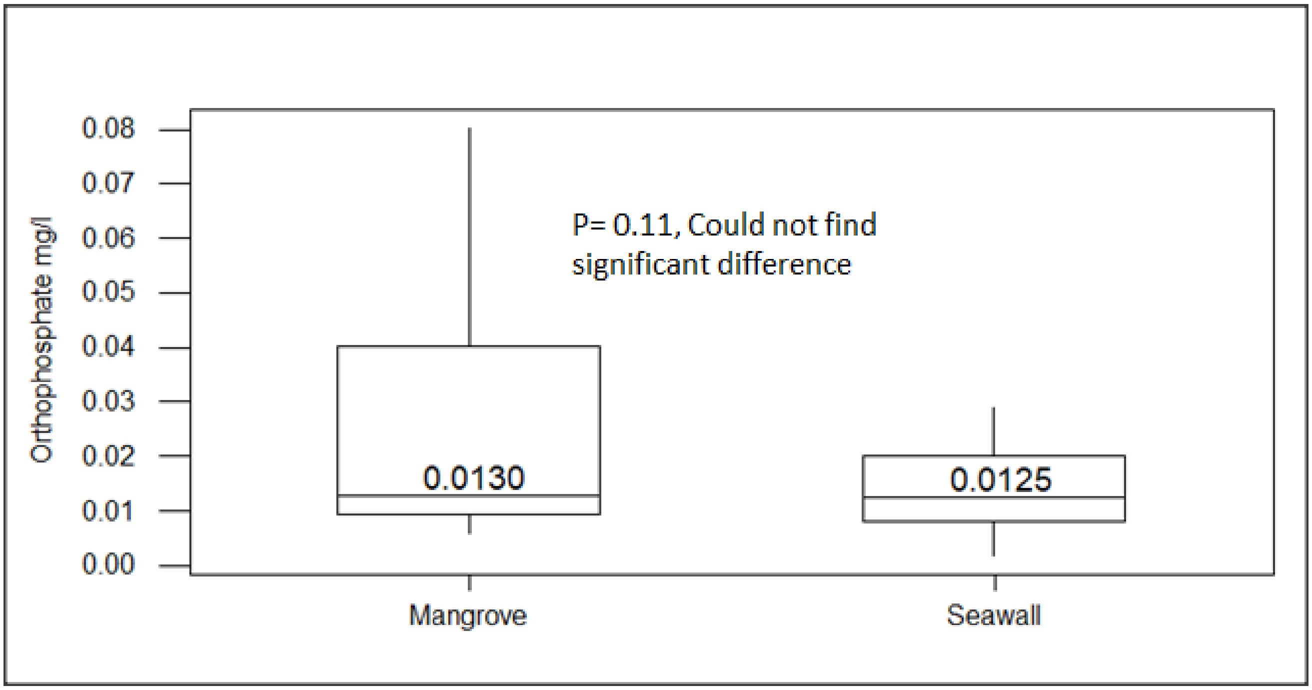

Figure 16. Mean orthophosphate concentration for canals bordered by mangroves compared to those bordered by seawall. No significant difference could be found. Kruskal-Wallis test.

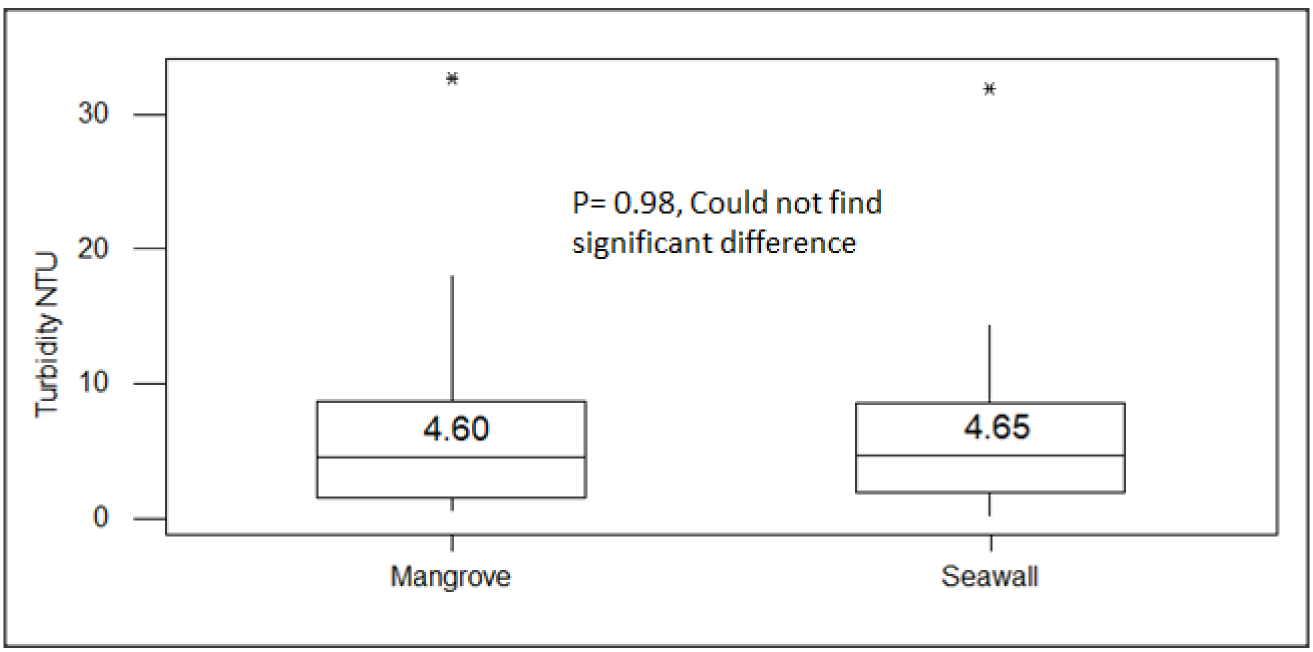

Figure 17. Mean turbidity for canals bordered by mangroves compared to those bordered by seawall. No significant difference could be found. Kruskal-Wallis test.

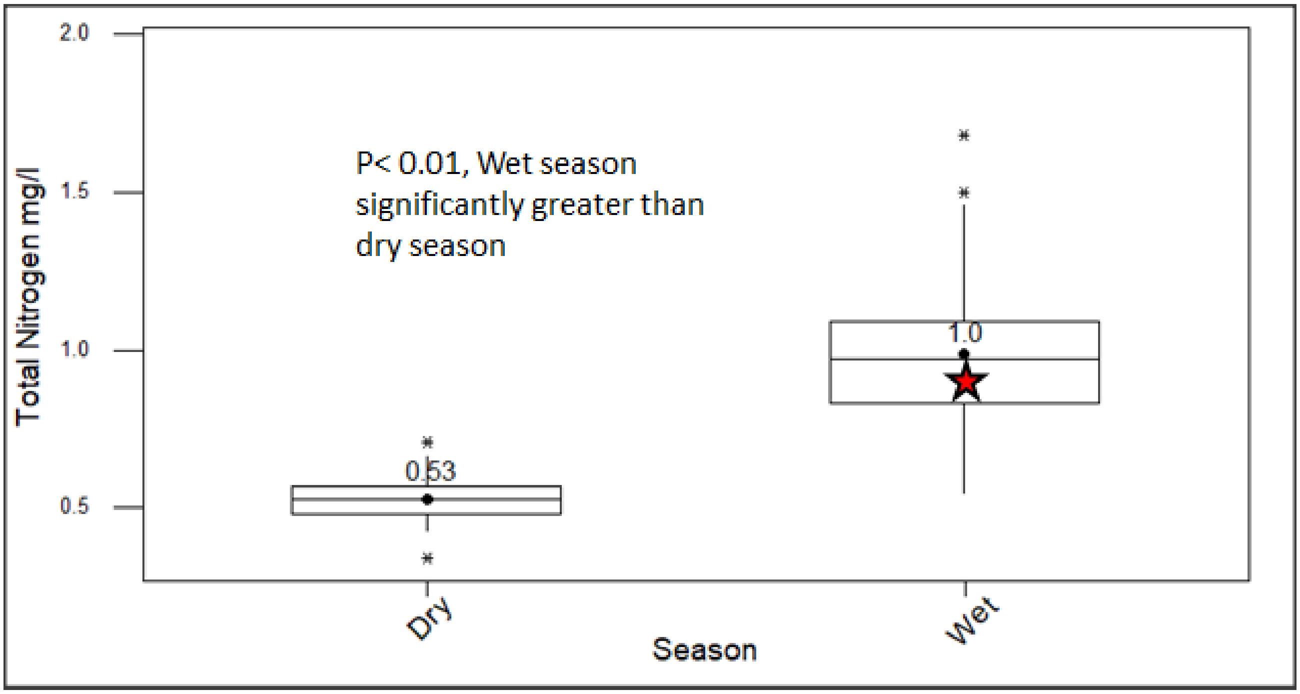

Figure 18. Mean total nitrogen concentration for canals in wet season compared to those in dry season. Significantly greater nitrogen found during wet season. Kruskal-Wallis test.

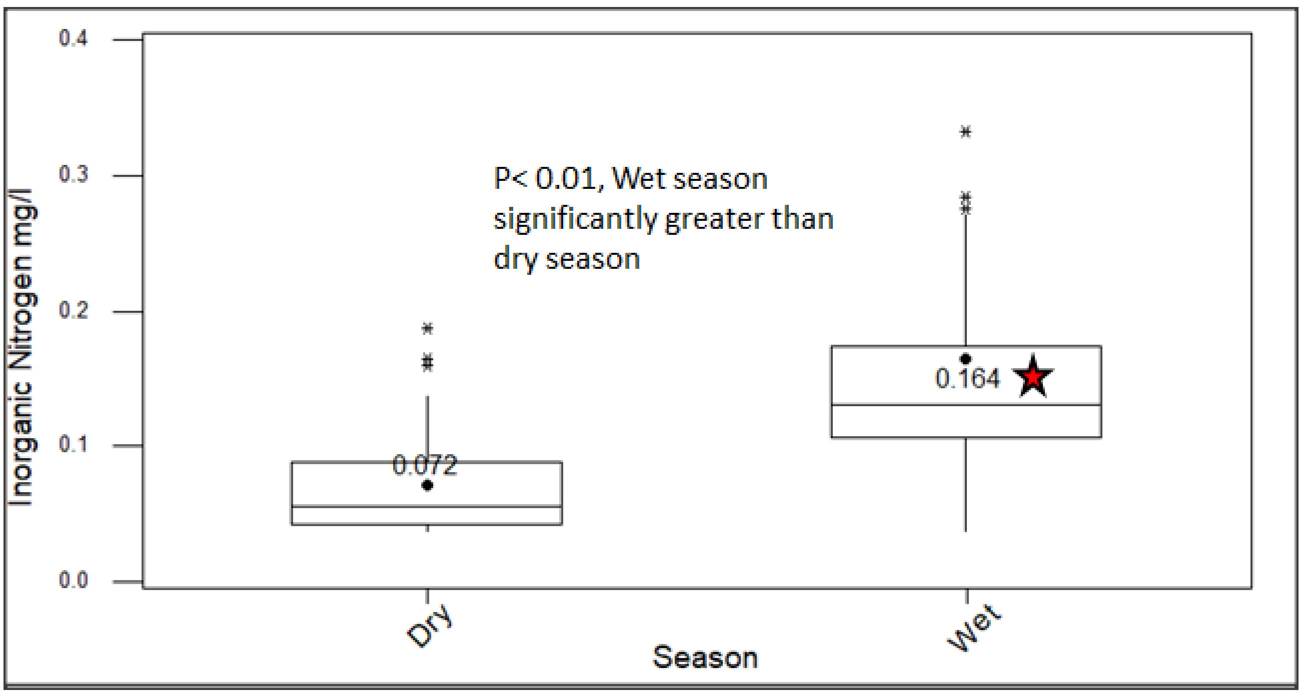

Figure 19. Mean inorganic nitrogen concentration for canals in wet season compared to those in dry season. Significantly greater IN found during wet season. Kruskal-Wallis test.

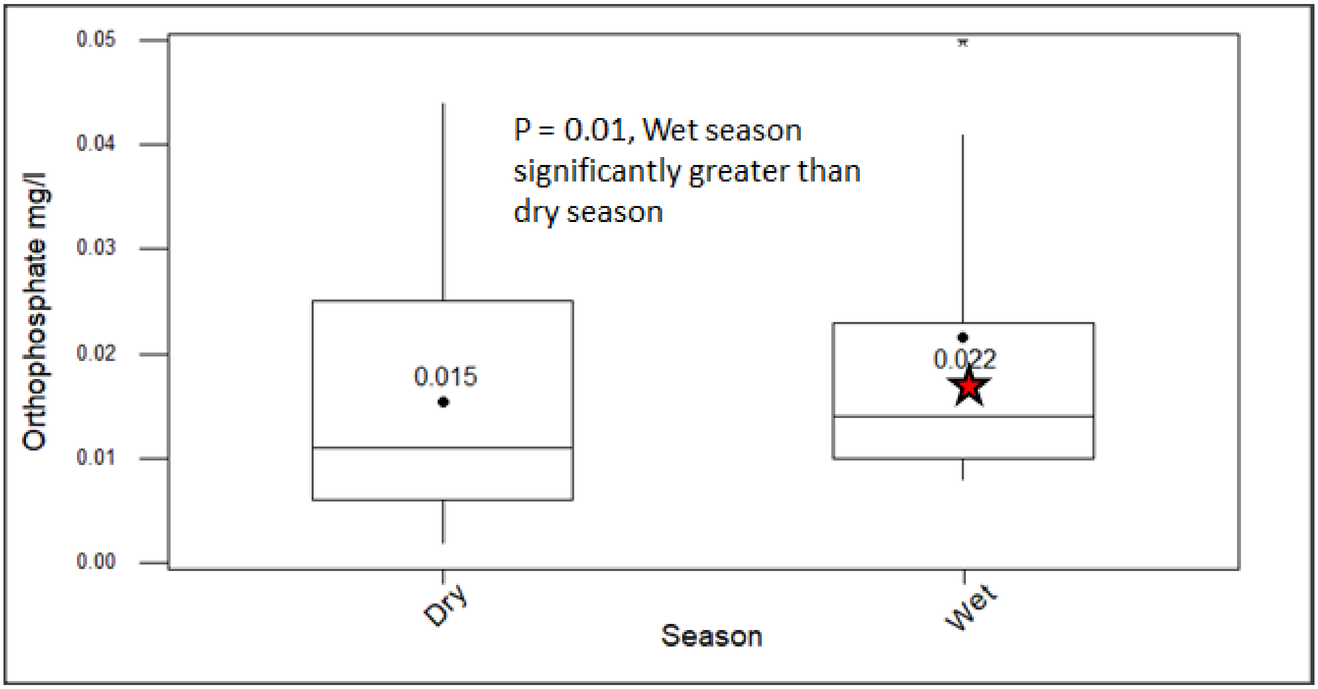

Figure 20. Mean total orthophosphate concentration for canals in wet season compared to those in dry season. Significantly greater OP found during wet season. Kruskal-Wallis test.

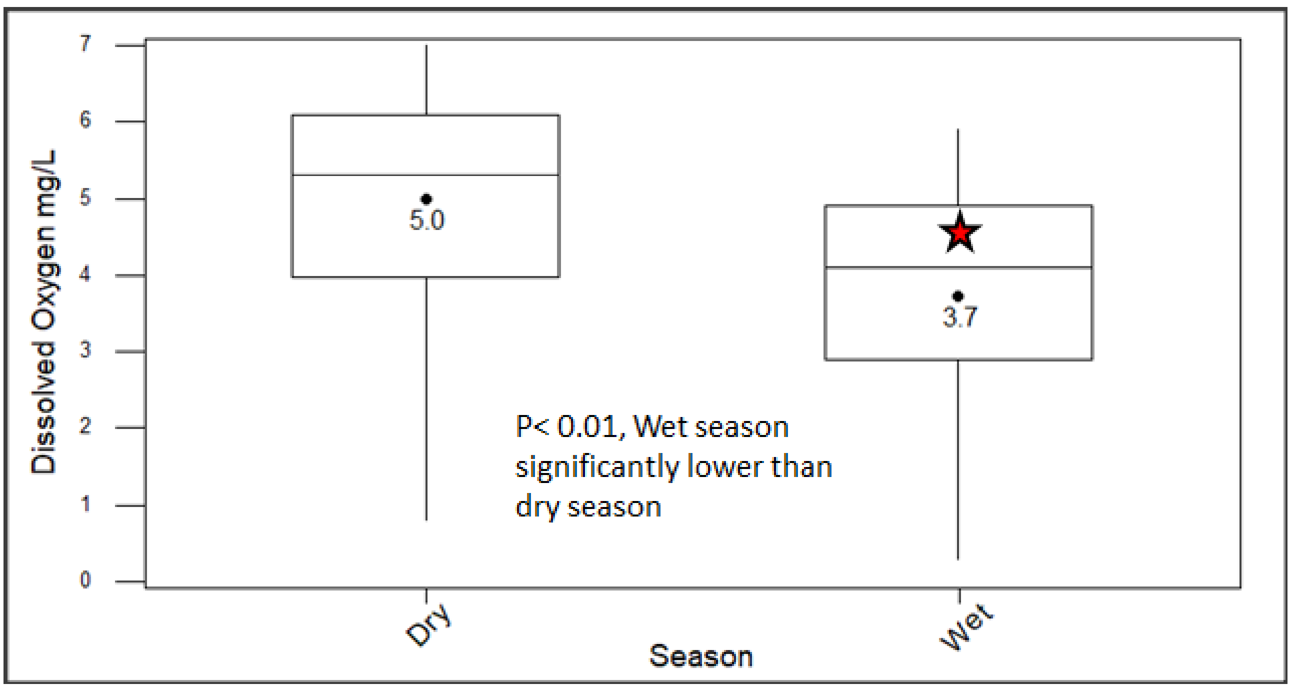

Figure 21. Mean dissolved oxygen concentration for canals in wet season compared to those in dry season. Significantly less DO found during wet season. Kruskal-Wallis test.

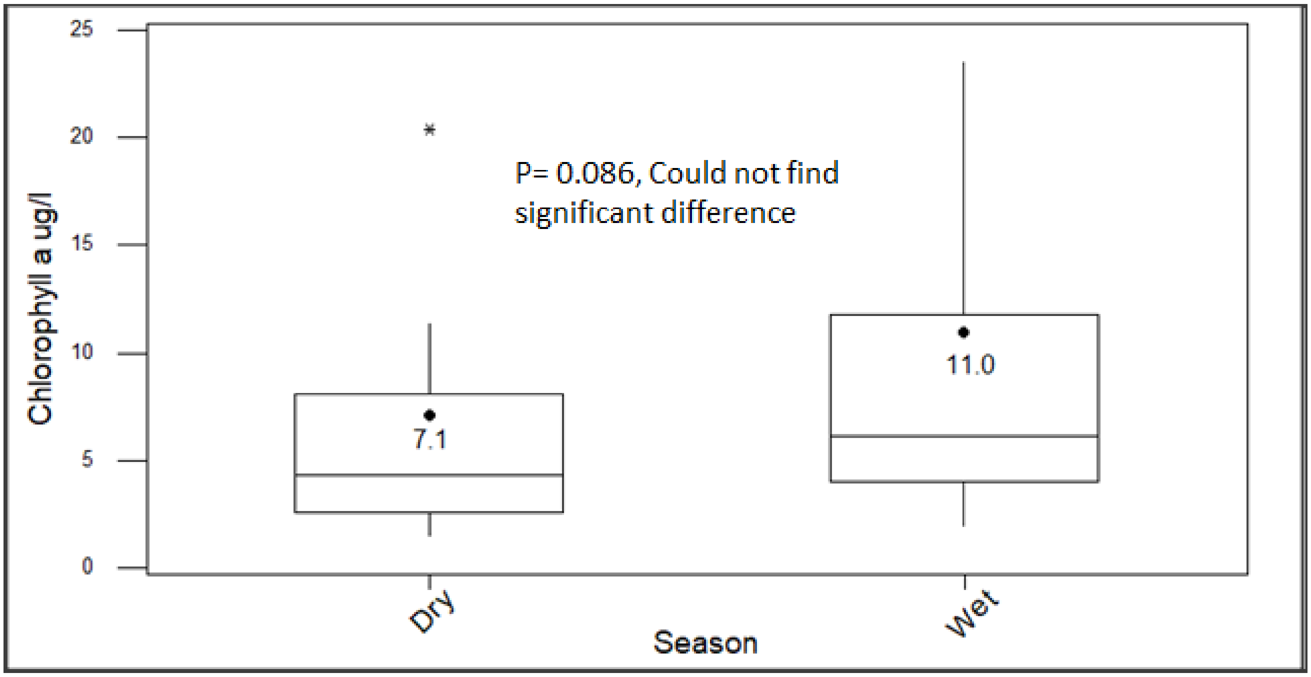

Figure 22. Mean chlorophyll *a* concentration for canals in wet season compared to those in dry season. No significant difference could be found between seasons. Kruskal-Wallis test.

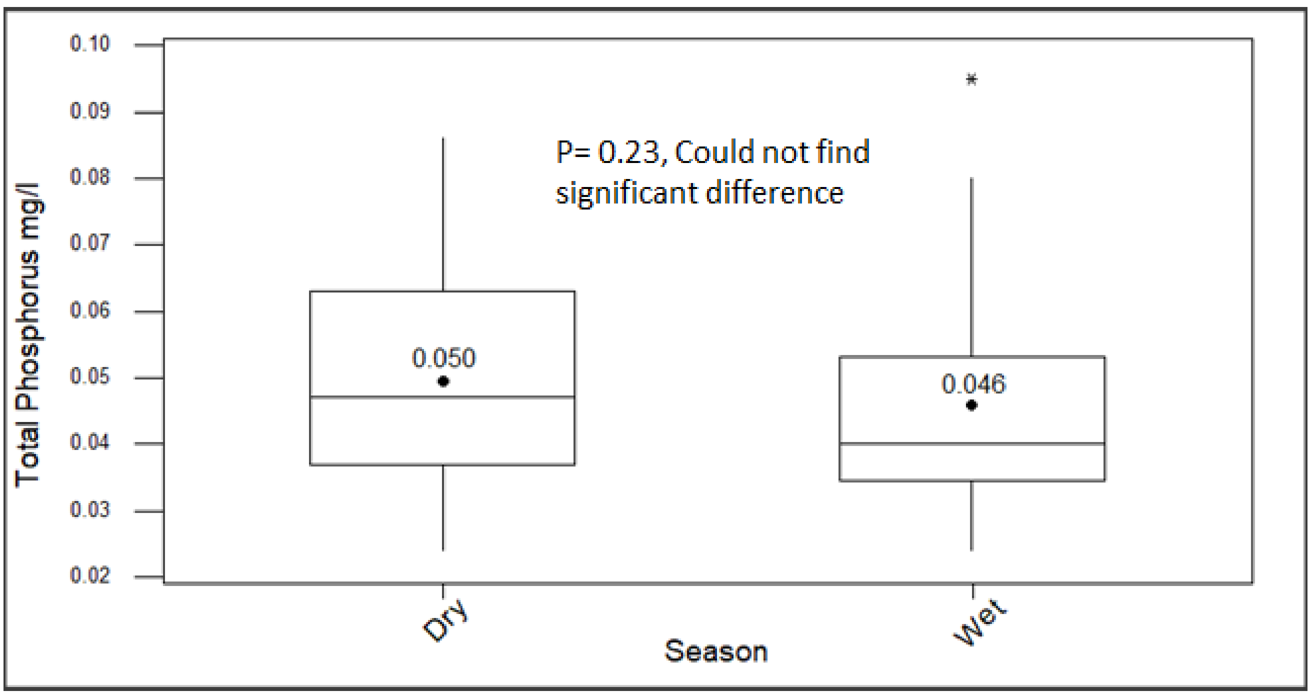

Figure 23. Mean total phosphorus concentration for canals in wet season compared to those in dry season. No significant difference could be found between seasons. Kruskal-Wallis test.

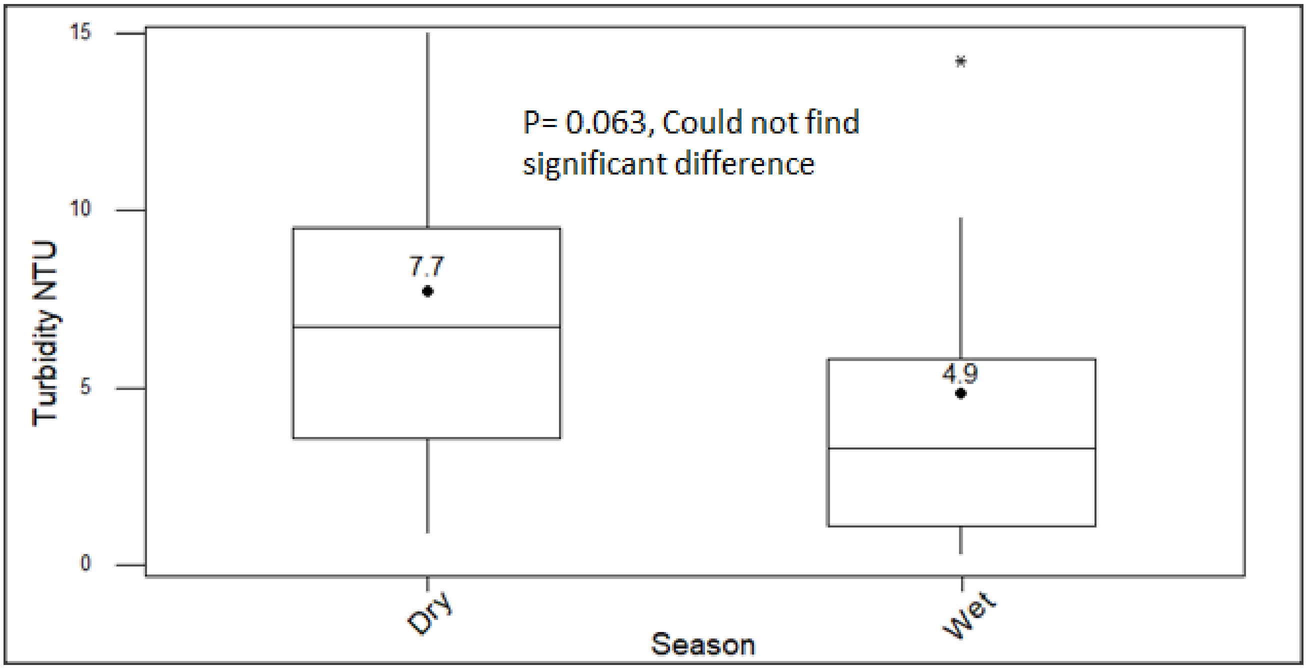

Figure 24. Mean turbidity for canals in wet season compared to those in dry season. No significant difference could be found between seasons. Kruskal-Wallis test.