

Guana Tolomato Matanzas National Estuarine Research Reserve

SEACAR Water Quality Analysis

Last compiled on 10 July, 2025

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Indicators

Nutrients

Total Nitrogen - Discrete

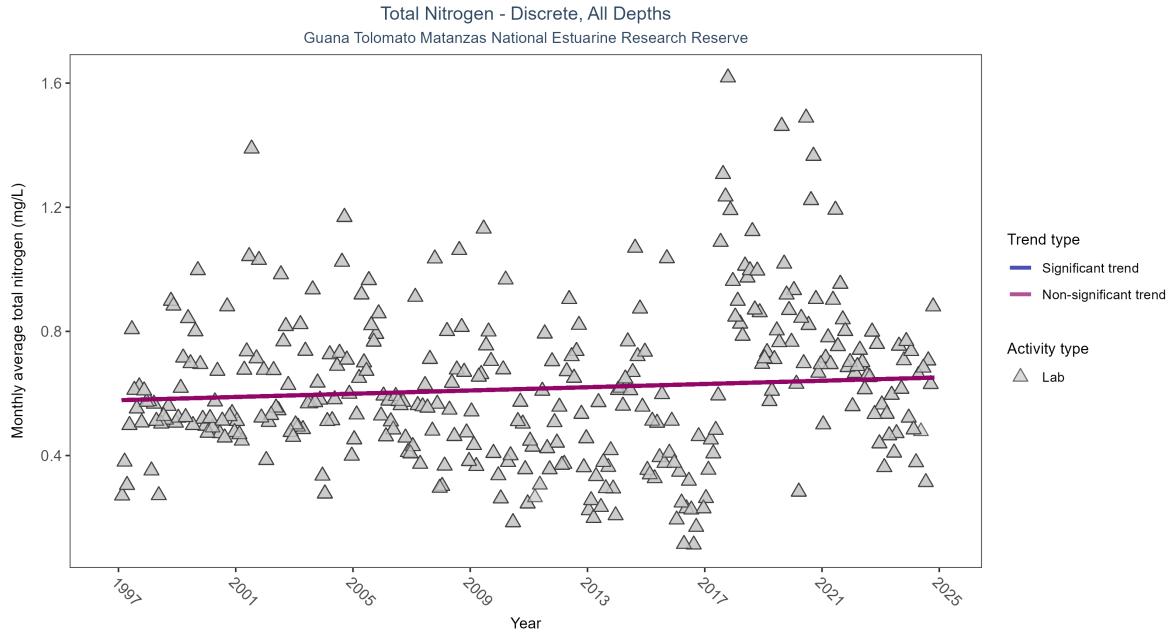


Figure 1: Scatter plot of monthly average total nitrogen over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only nitrogen values obtained from laboratory analyses (triangles) are included in the plot.

Table 1: Seasonal Kendall-Tau Results for - Total Nitrogen

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Lab	No significant trend	5960	28	1997 - 2024	0.5545	0.07049	0.57824	0.00262	0.0751

Total nitrogen showed no detectable trend between 1997 and 2024.

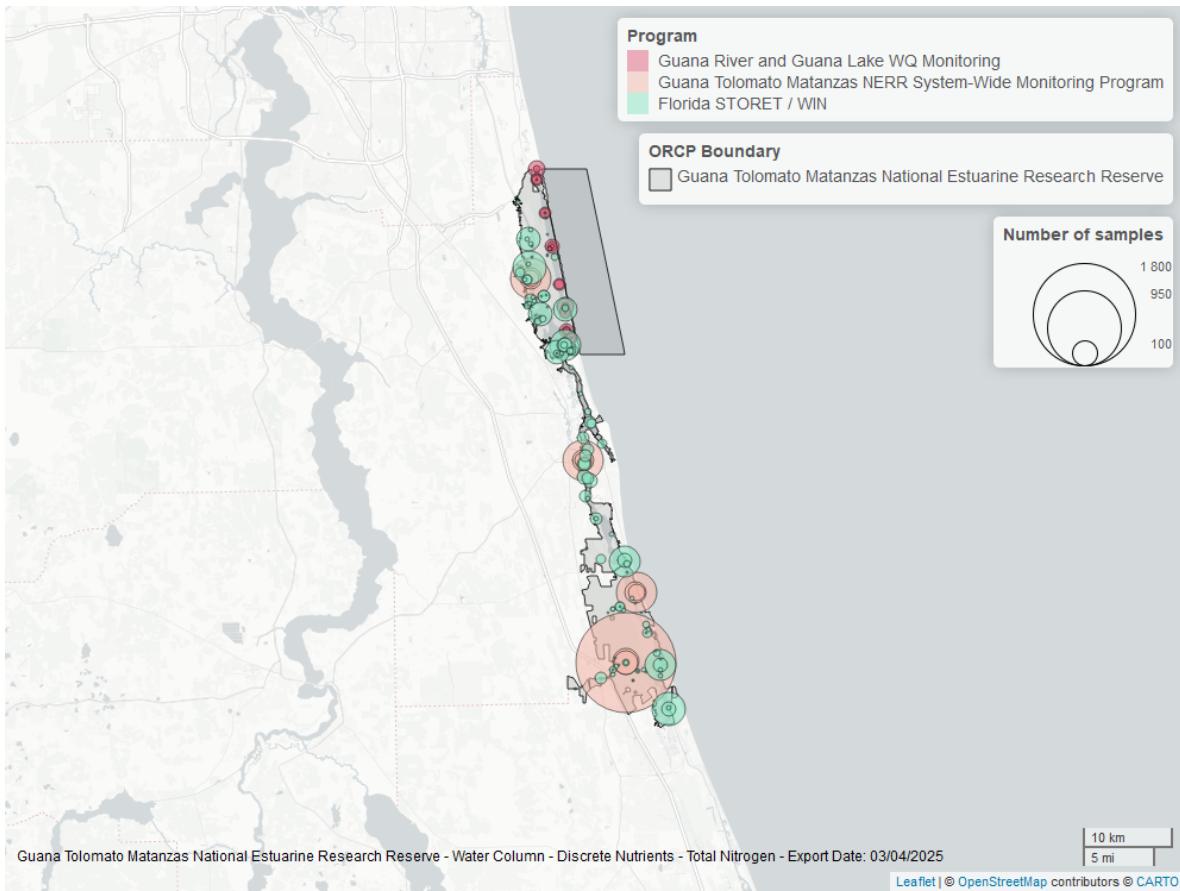


Figure 2: Map showing location of discrete water quality sampling locations within the boundaries of *Guana Tolomato Matanzas National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Total Phosphorus - Discrete

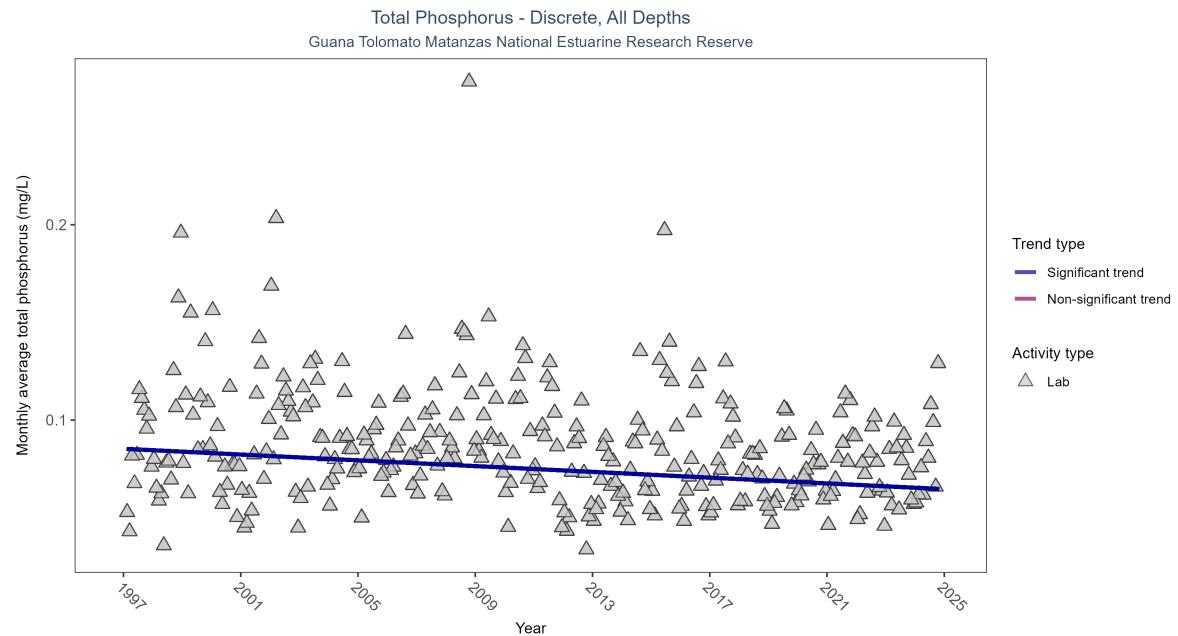


Figure 3: Scatter plot of monthly average total phosphorus over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only phosphorus values obtained from laboratory analyses (triangles) are included in the plot.

Table 2: Seasonal Kendall-Tau Results for - Total Phosphorus

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Lab	Significantly decreasing trend	9346	28	1997 - 2024	0.072	-0.2044	0.08532	-0.00074	0

Monthly average total phosphorus decreased by less than 0.01 mg/L per year.

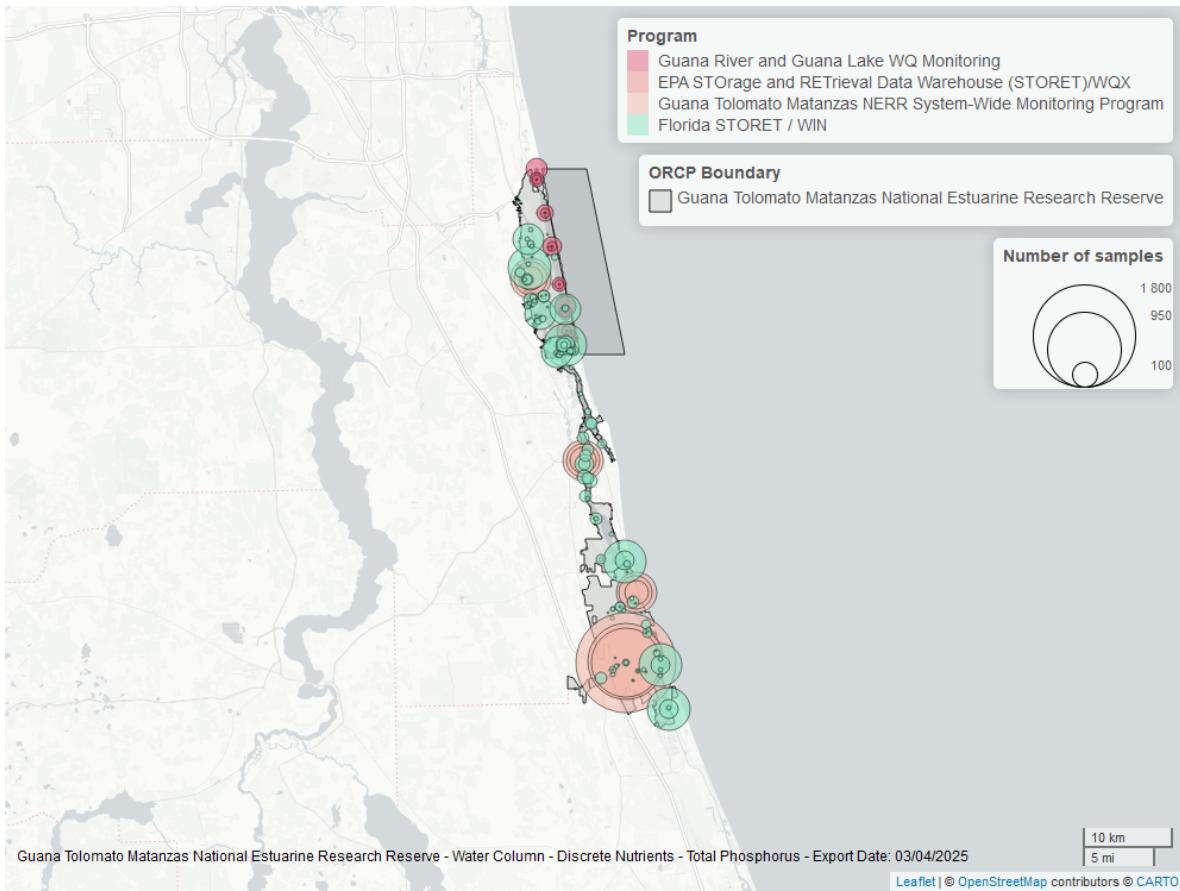


Figure 4: Map showing location of discrete water quality sampling locations within the boundaries of *Guana Tolomato Matanzas National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Water Quality

Dissolved Oxygen - Discrete

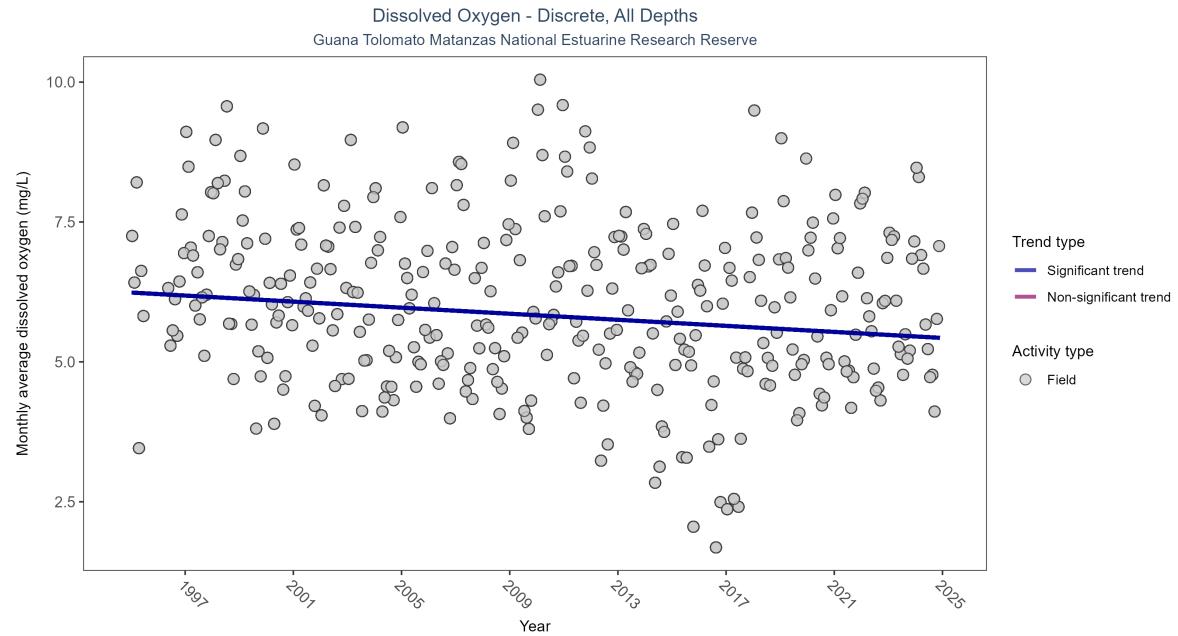


Figure 5: Scatter plot of monthly average dissolved oxygen over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only dissolved oxygen values measured in the field (circles) are included in the plot.

Table 3: Seasonal Kendall-Tau Results for - Dissolved Oxygen

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Field	Significantly decreasing trend	22400	30	1995 - 2024	5.99	-0.16934	6.2392	-0.02706	0

Monthly average dissolved oxygen decreased by 0.03 mg/L per year.

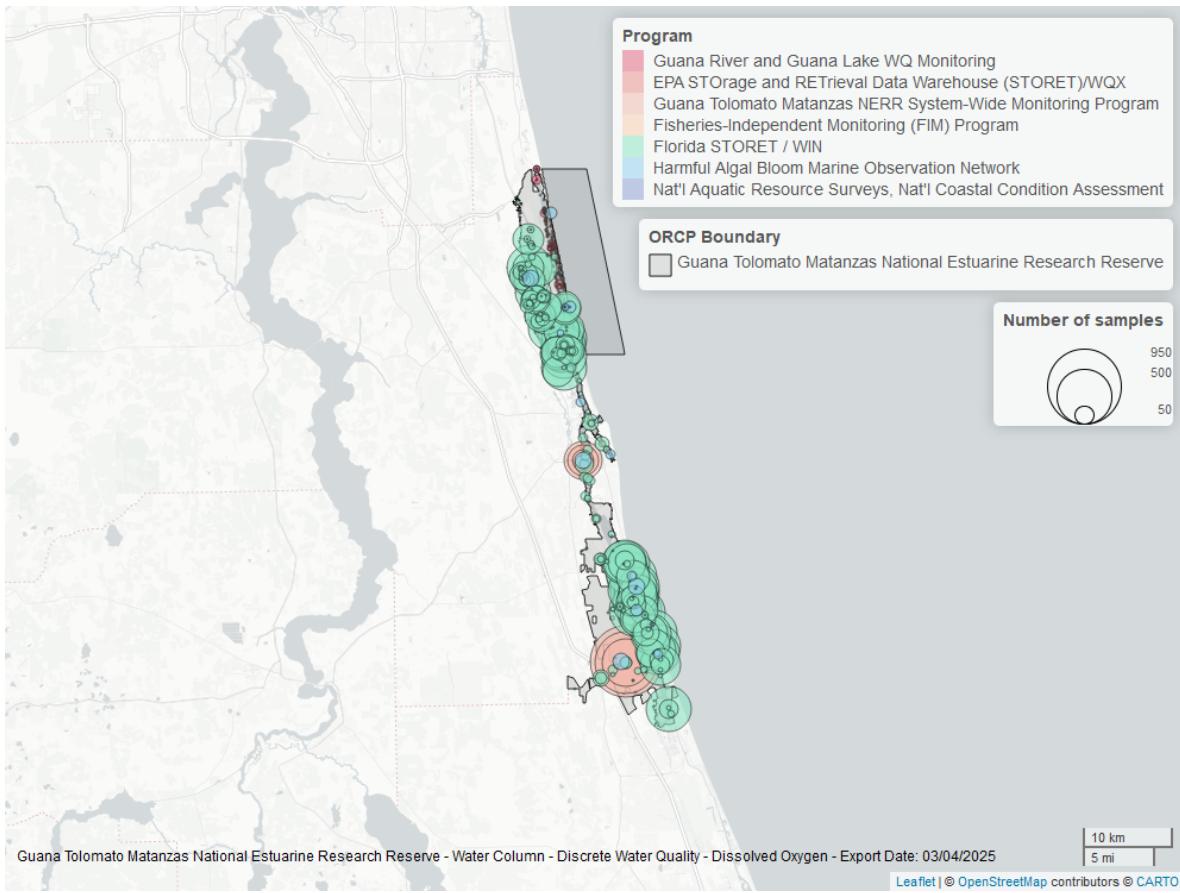


Figure 6: Map showing location of discrete water quality sampling locations within the boundaries of *Guana Tolomato Matanzas National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Dissolved Oxygen - Continuous

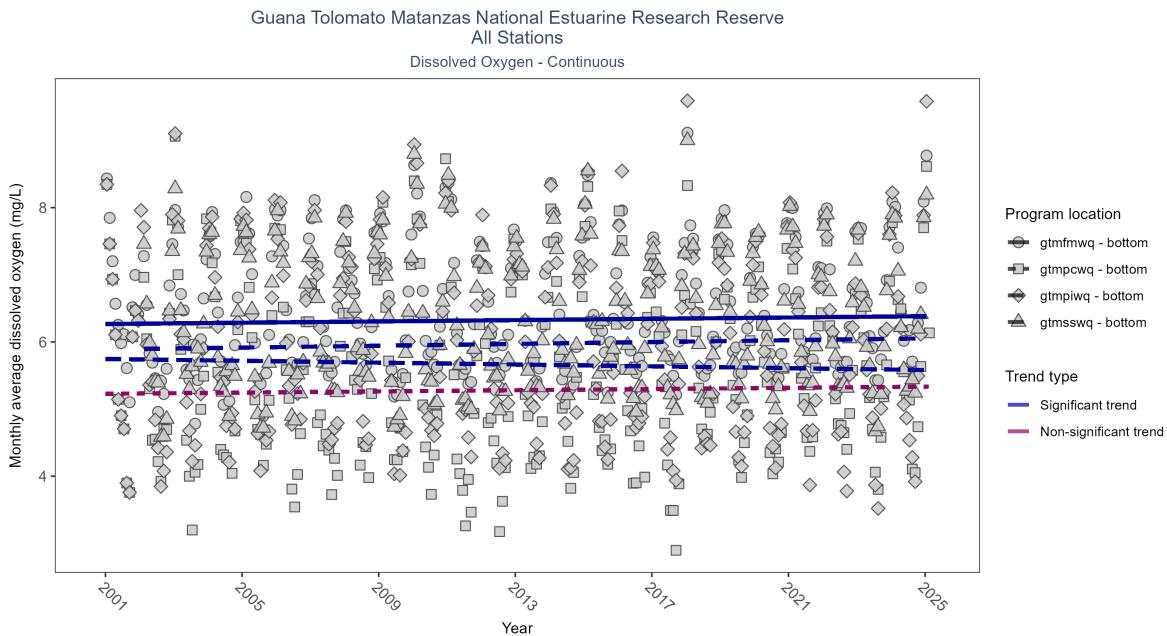


Figure 7: Scatter plot of monthly average dissolved oxygen over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 4: Seasonal Kendall-Tau Results - Dissolved Oxygen

Program Location	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
gtmsswq	Significantly increasing trend	661972	24	2002 - 2025	6.3	0.10	5.89	0.01	0.0257
gtmpiwq	Significantly decreasing trend	665008	25	2001 - 2025	5.9	-0.09	5.75	-0.01	0.0424
gtmfmwq	Significantly increasing trend	683159	25	2001 - 2025	6.5	0.10	6.27	0.00	0.0239
gtmpewq	No significant trend	703770	25	2001 - 2025	5.5	0.04	5.23	0.00	0.3292

At two program locations, monthly average dissolved oxygen increased by less than 0.01 mg/L per year at one site and by 0.01 mg/L per year at the other. At one program location, monthly average dissolved oxygen decreased by 0.01 mg/L per year. No detectable change in monthly average dissolved oxygen was observed at one location.

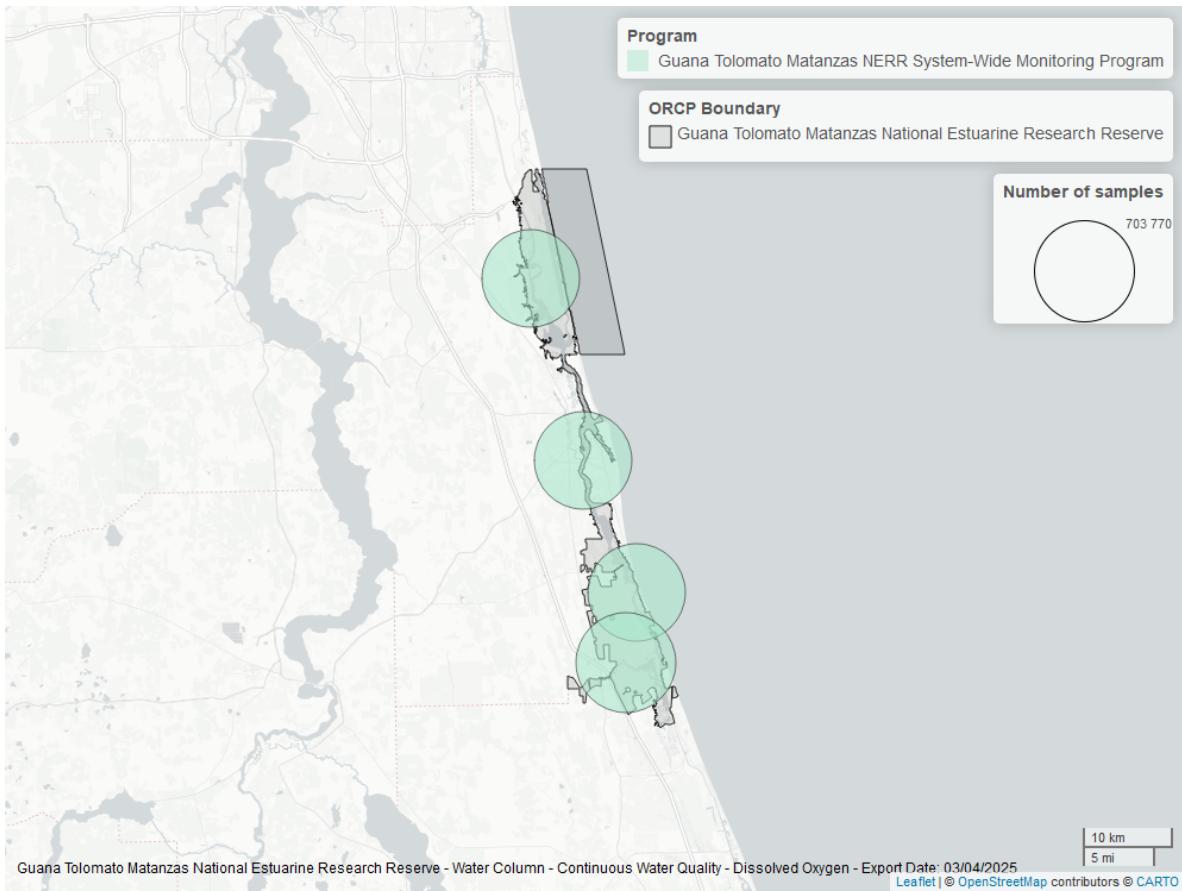


Figure 8: Map showing location of dissolved oxygen continuous water quality sampling locations within the boundaries of *Guana Tolomato Matanzas National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Dissolved Oxygen Saturation - Discrete

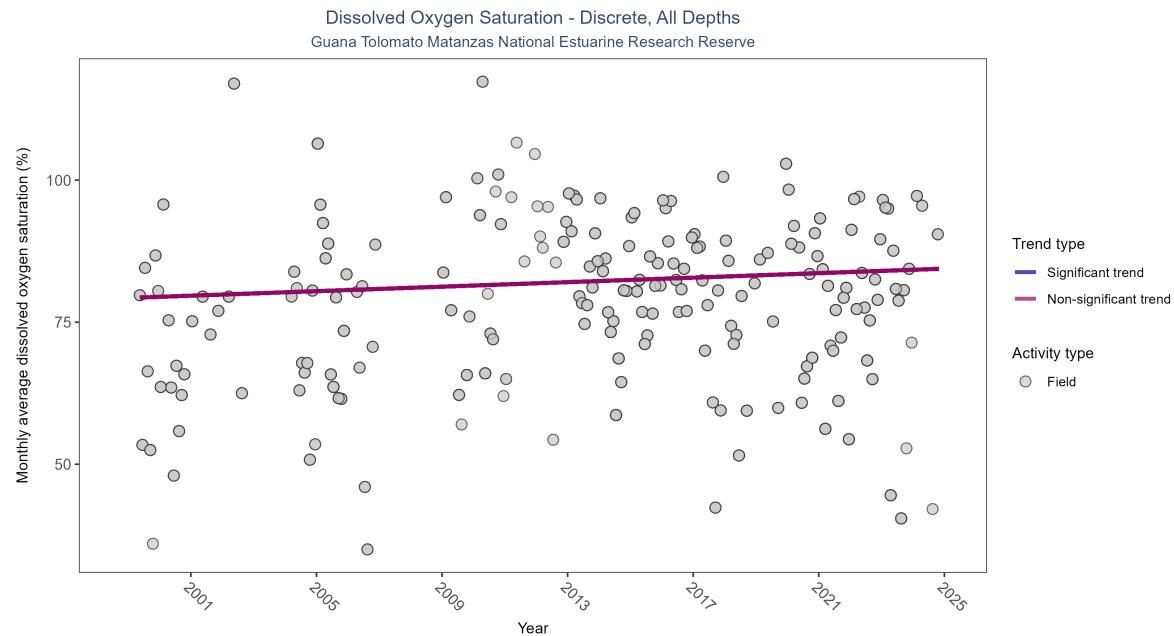


Figure 9: Scatter plot of monthly average dissolved oxygen saturation over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only dissolved oxygen saturation values measured in the field (circles) are included in the plot.

Table 5: Seasonal Kendall-Tau Results for - Dissolved Oxygen Saturation

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Field	No significant trend	2351	23	1999 - 2024	81.2	0.08569	79.26809	0.19836	0.1062

Dissolved oxygen saturation showed no detectable trend between 1999 and 2024.

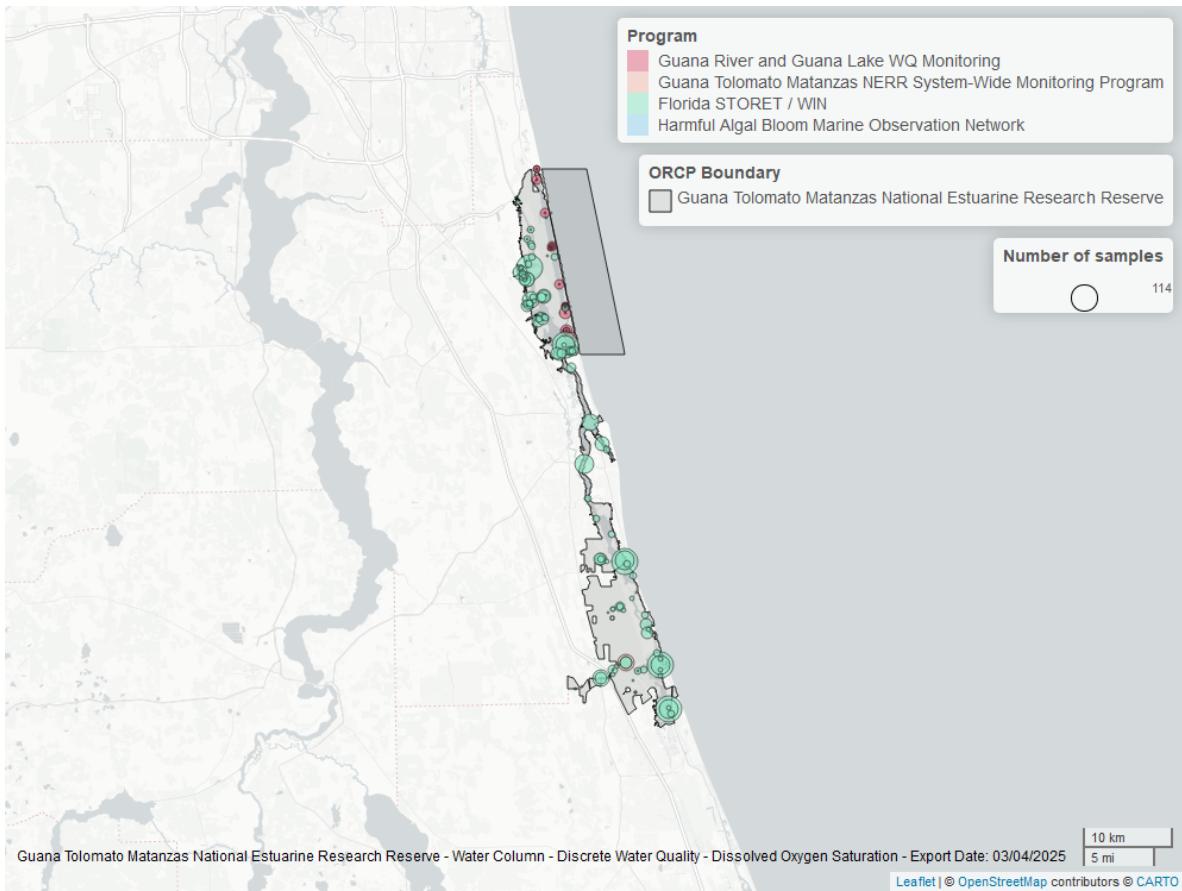


Figure 10: Map showing location of discrete water quality sampling locations within the boundaries of *Guana Tolomato Matanzas National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Dissolved Oxygen Saturation - Continuous

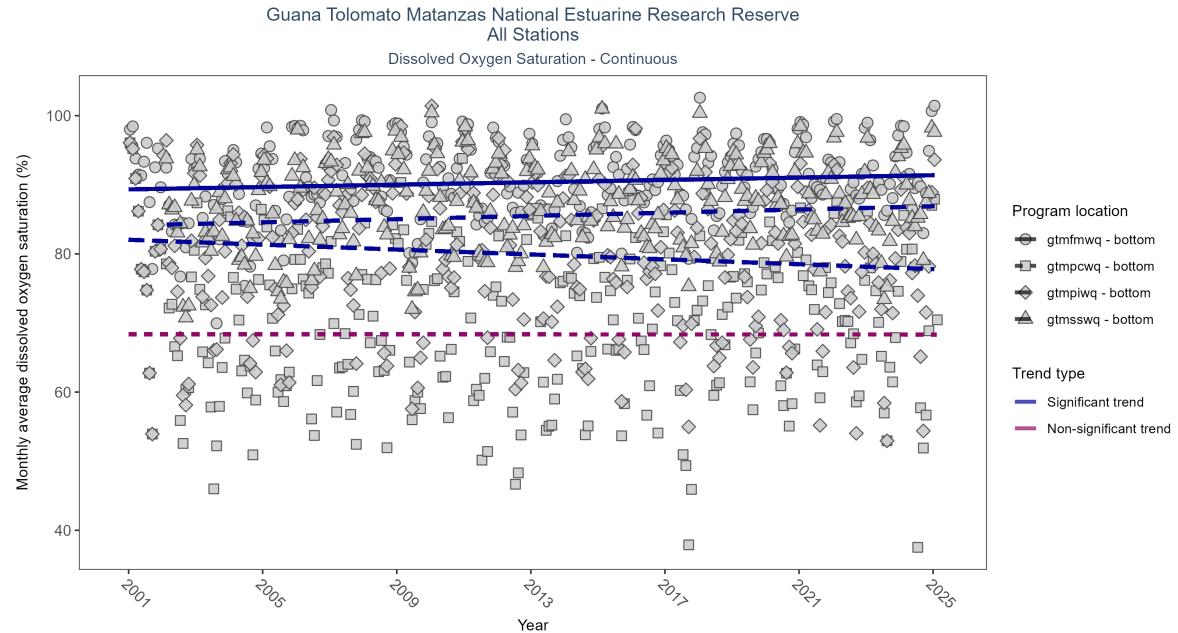


Figure 11: Scatter plot of monthly average dissolved oxygen saturation over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 6: Seasonal Kendall-Tau Results - Dissolved Oxygen Saturation

Program Location	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
gtmpiwq	Significantly decreasing trend	670820	25	2001 - 2025	82.2	-0.18	82.04	-0.18	0
gtmsswq	Significantly increasing trend	667908	24	2002 - 2025	89.5	0.15	84.22	0.12	0.0005
gtmfmwq	Significantly increasing trend	694826	25	2001 - 2025	92.6	0.15	89.33	0.09	0.0005
gtmpcwq	No significant trend	705263	25	2001 - 2025	71.4	0.00	68.37	0.00	0.9716

At two program locations, monthly average dissolved oxygen saturation increased by 0.09% per year at one site and by 0.12% per year at the other. At one program location, monthly average dissolved oxygen saturation decreased by 0.18% per year. No detectable change in monthly average dissolved oxygen saturation was observed at one location.

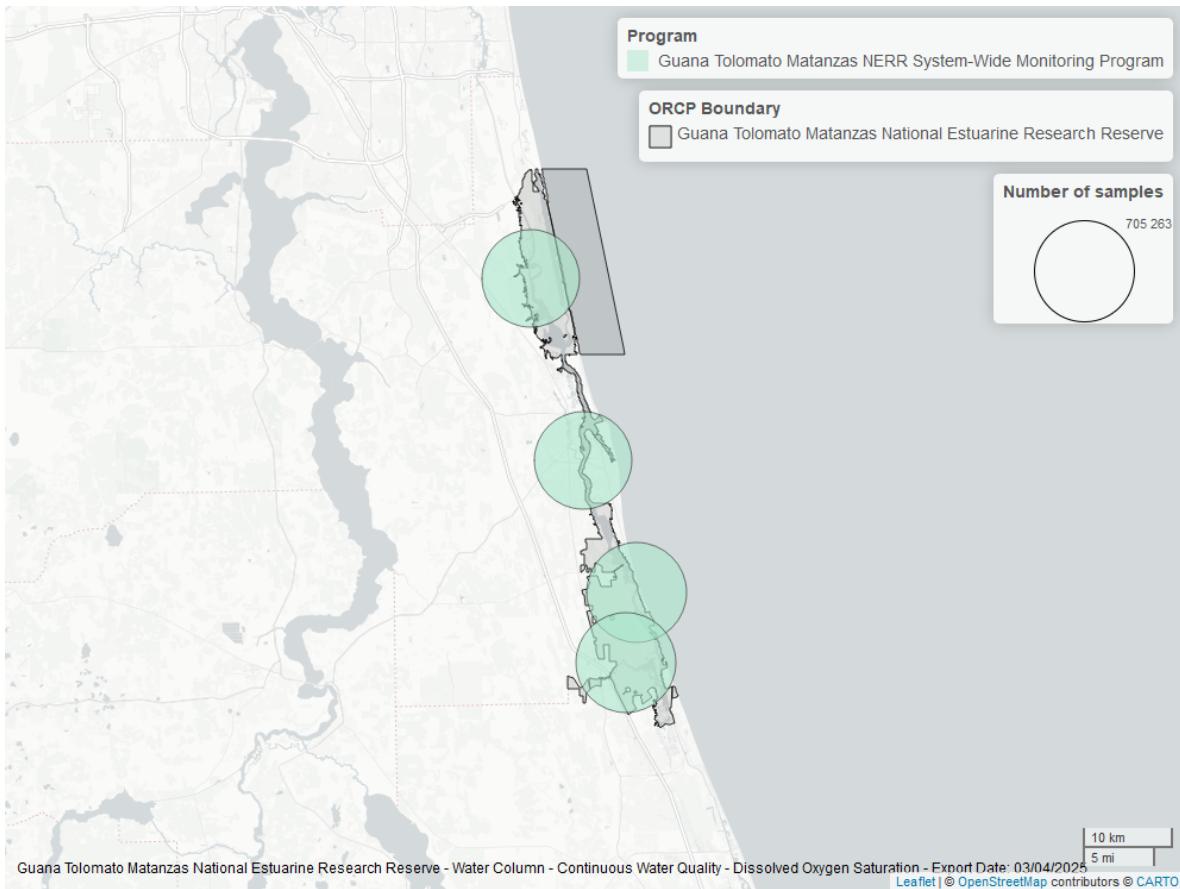


Figure 12: Map showing location of dissolved oxygen saturation continuous water quality sampling locations within the boundaries of *Guana Tolomato Matanzas National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Salinity - Discrete

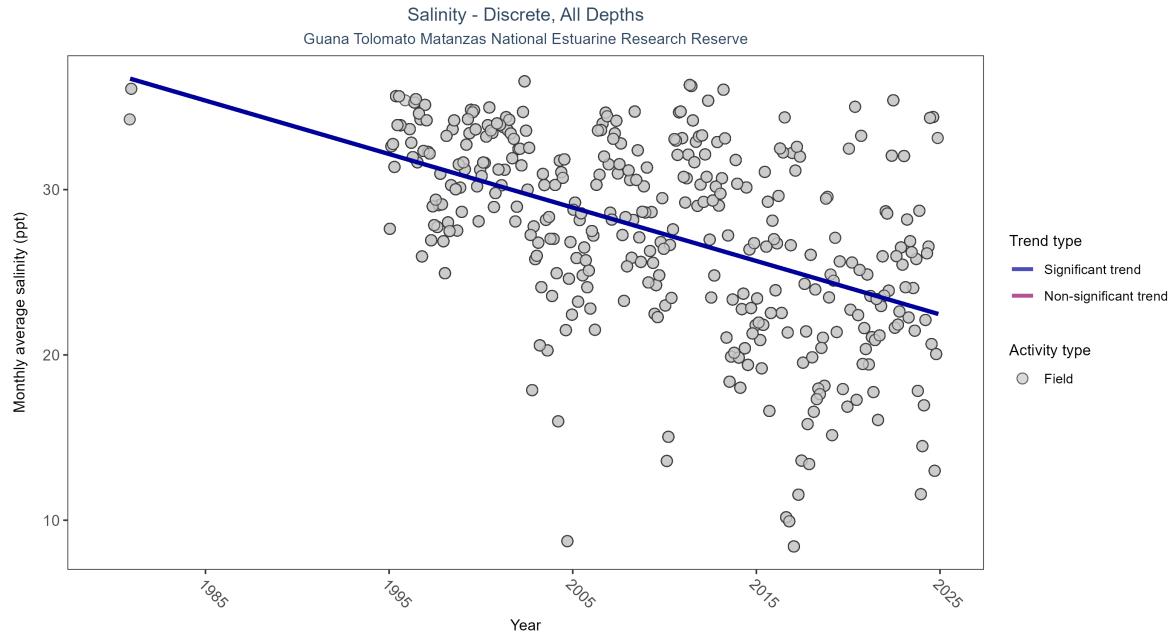


Figure 13: Scatter plot of monthly average salinity over time. If the time series included ten or more years of discrete observations, significant (blue) or non-significant (magenta) trend lines are also shown. Discrete salinity values derived from grab samples analyzed in the field (circles) or the laboratory (triangles) are both included in the plot.

Table 7: Seasonal Kendall-Tau Results for - Salinity

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
All	Significantly decreasing trend	25641	31	1980 - 2024	31.71	-0.36104	37.00413	-0.32348	0

Monthly average salinity decreased by 0.32 ppt per year.

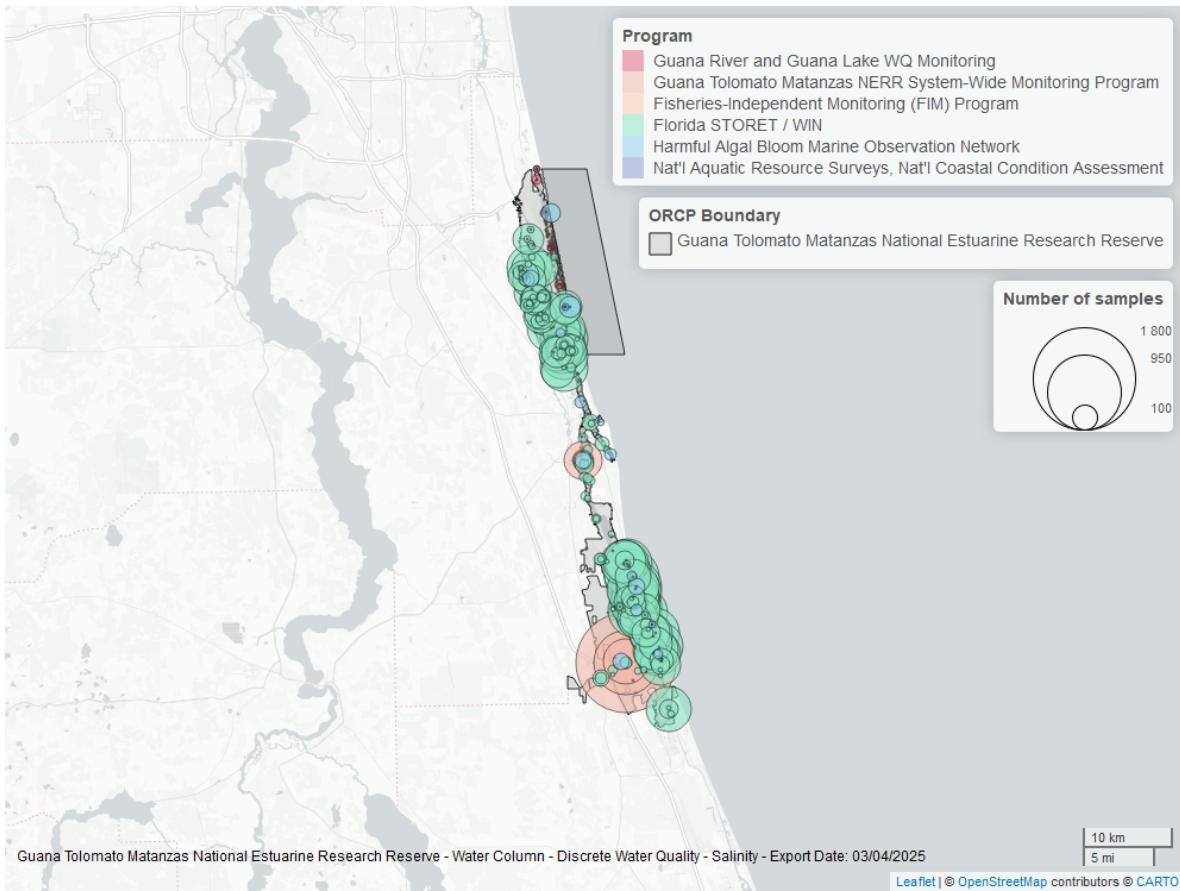


Figure 14: Map showing location of discrete water quality sampling locations within the boundaries of *Guana Tolomato Matanzas National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Salinity - Continuous

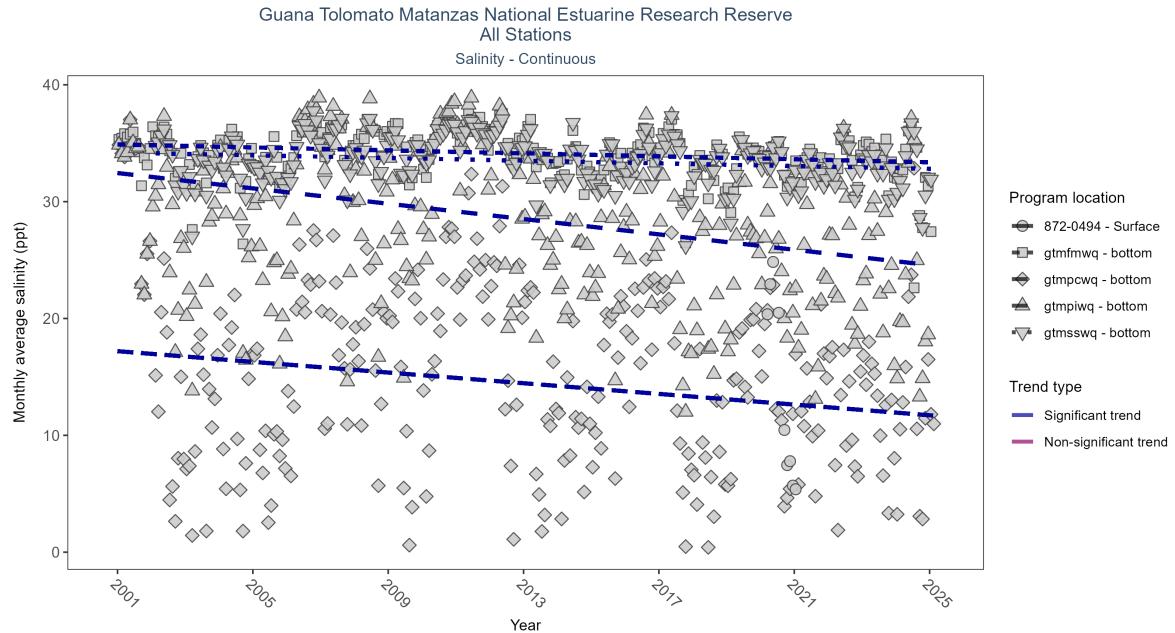


Figure 15: Scatter plot of monthly average salinity over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 8: Seasonal Kendall-Tau Results - Salinity

Program Location	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
gtmsswq	Significantly decreasing trend	646637	24	2002 - 2025	33.90	-0.12	34.14	-0.06	0.0047
gtmpiwq	Significantly decreasing trend	666468	24	2001 - 2024	27.90	-0.26	32.45	-0.33	0
gtmmfwq	Significantly decreasing trend	671050	25	2001 - 2025	34.40	-0.17	34.89	-0.06	0
gtmpcwq	Significantly decreasing trend	713330	25	2001 - 2025	16.60	-0.14	17.2	-0.23	0.0008
872-0494	Insufficient data to calculate trend	34918	2	2020 - 2021	8.99	-	-	-	-

At four program locations, monthly average salinity decreased between 0.06 and 0.33 ppt per year. There was insufficient data to fit a model for one location.

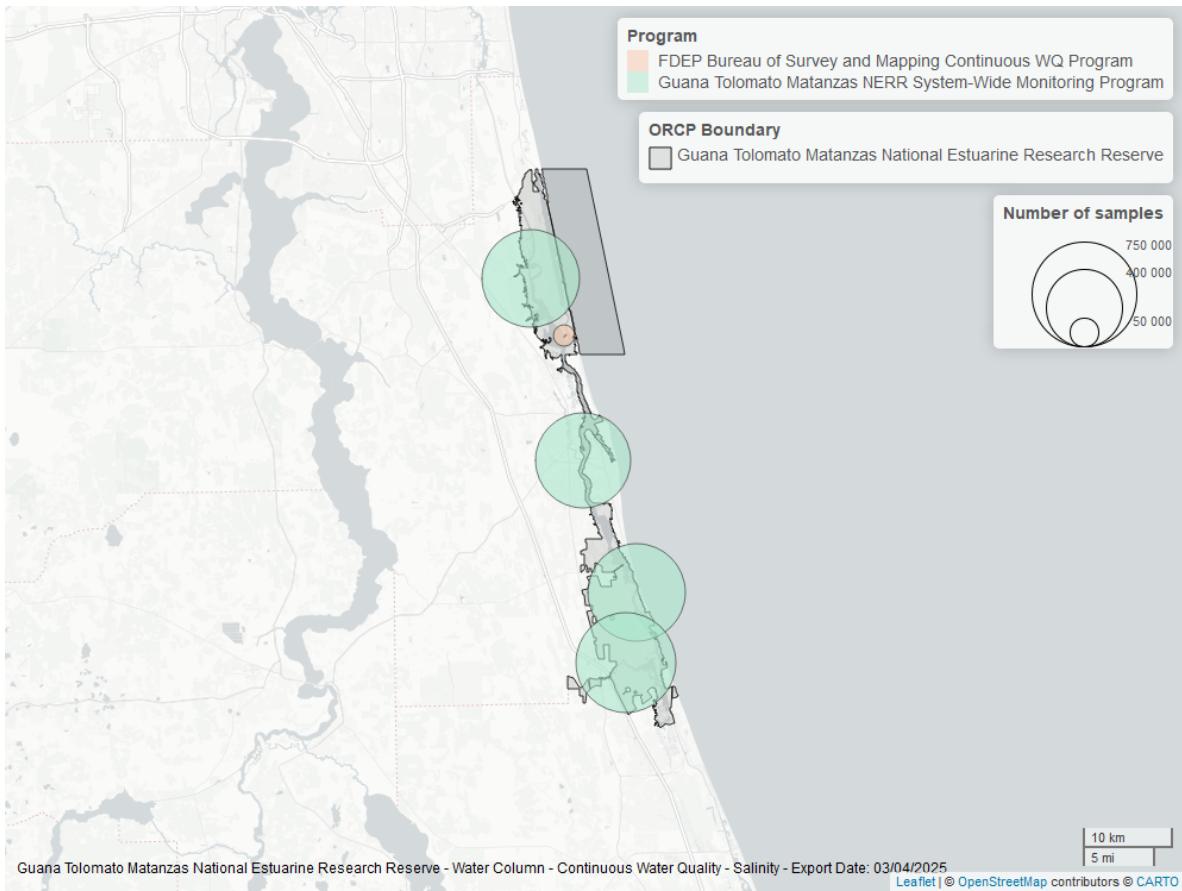


Figure 16: Map showing location of salinity continuous water quality sampling locations within the boundaries of *Guana Tolomato Matanzas National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Water Temperature - Discrete

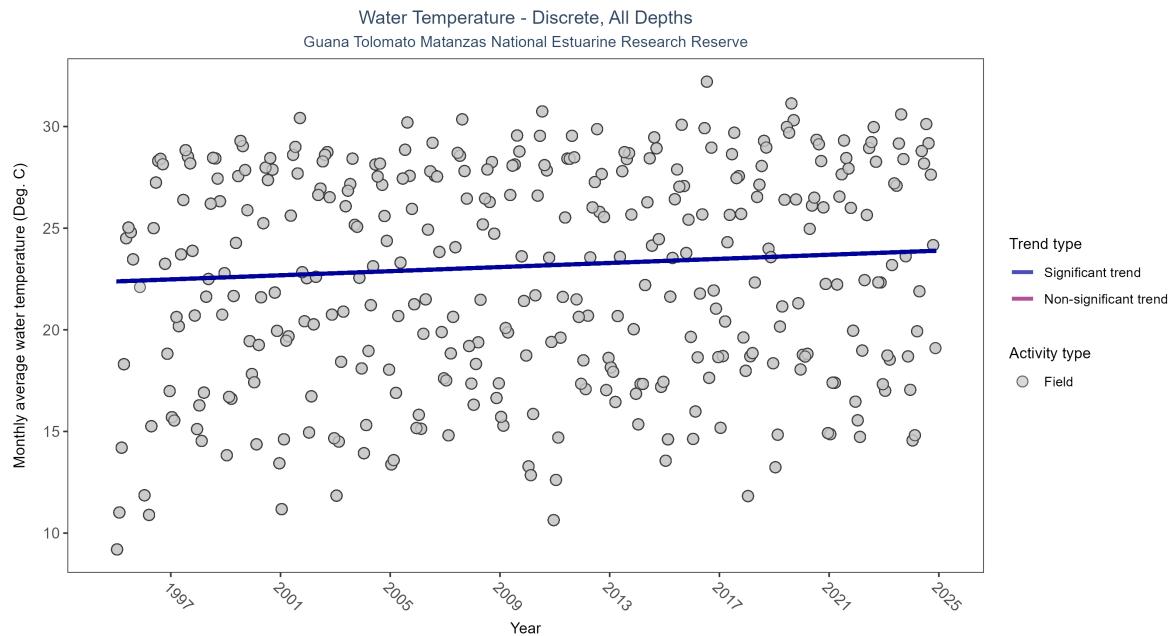


Figure 17: Scatter plot of monthly average water temperature over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only water temperature measurements taken in the field (circles) are included in the plot.

Table 9: Seasonal Kendall-Tau Results for - Water Temperature

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Field	Significantly increasing trend	25291	30	1995 - 2024	23.3	0.21369	22.37929	0.05051	0

Monthly average water temperature increased by 0.05°C per year.

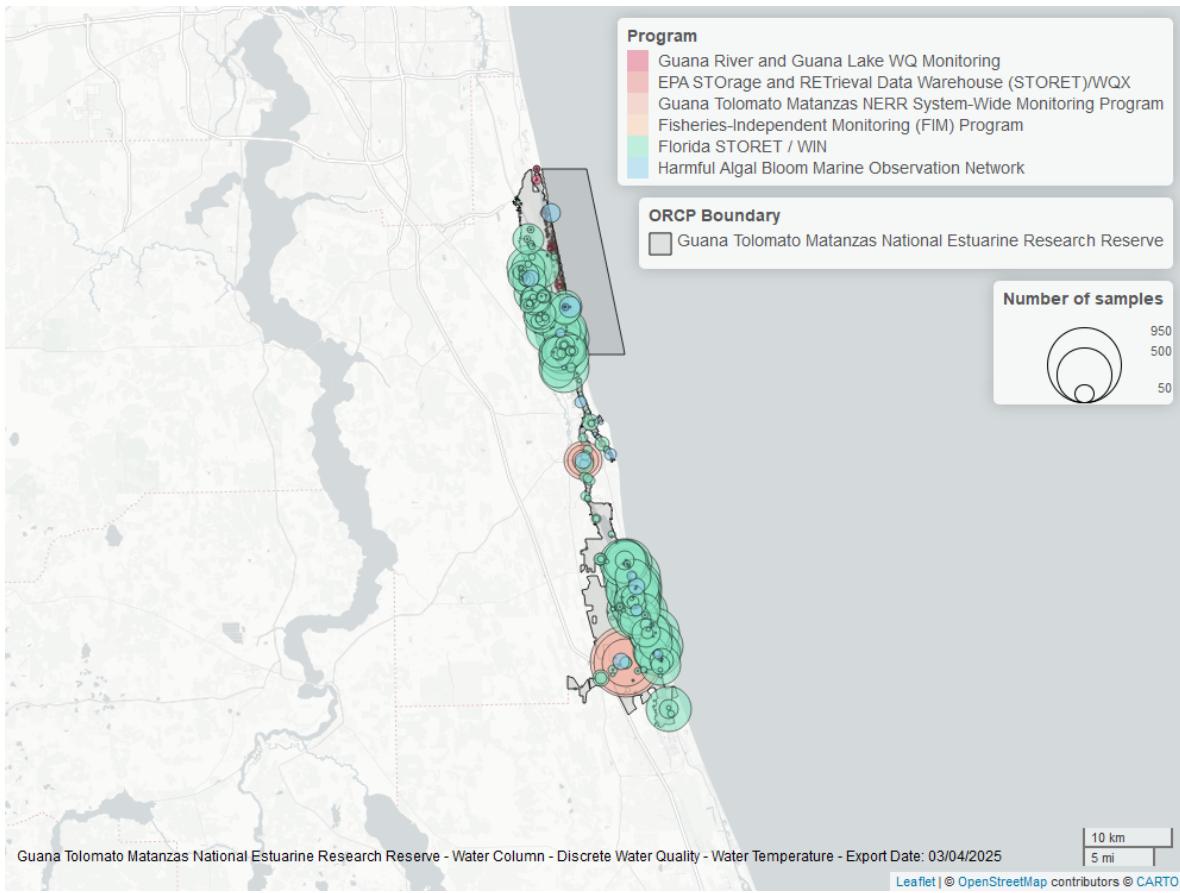


Figure 18: Map showing location of discrete water quality sampling locations within the boundaries of *Guana Tolomato Matanzas National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Water Temperature - Continuous

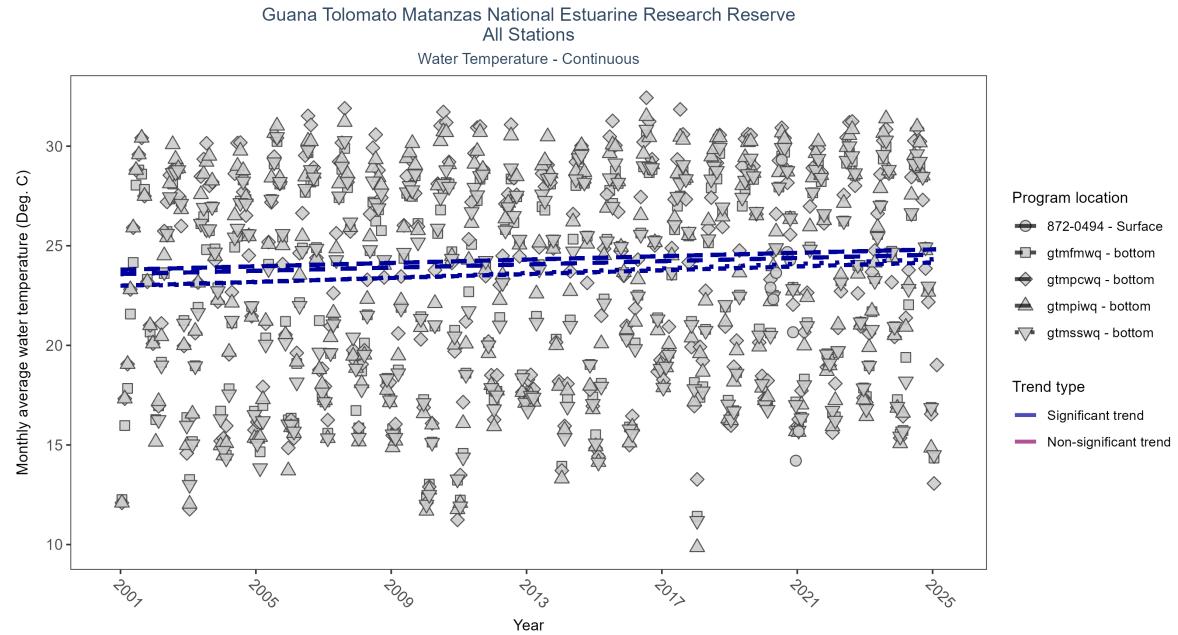


Figure 19: Scatter plot of monthly average water temperature over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 10: Seasonal Kendall-Tau Results - Water Temperature

Program Location	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
gtmcwq	Significantly increasing trend	721896	25	2001 - 2025	24.30	0.15	23.8	0.04	0.0004
gtmfmwq	Significantly increasing trend	714709	25	2001 - 2025	23.70	0.23	23	0.05	0
gtmsswq	Significantly increasing trend	680248	24	2002 - 2025	23.80	0.23	23	0.06	0
gtmpiwq	Significantly increasing trend	716752	24	2001 - 2024	24.30	0.19	23.58	0.04	0
872-0494	Insufficient data to calculate trend	35473	2	2020 - 2021	22.34	-	-	-	-

At four program locations, monthly average water temperature increased between 0.04 and 0.06°C per year. There was insufficient data to fit a model for one location.

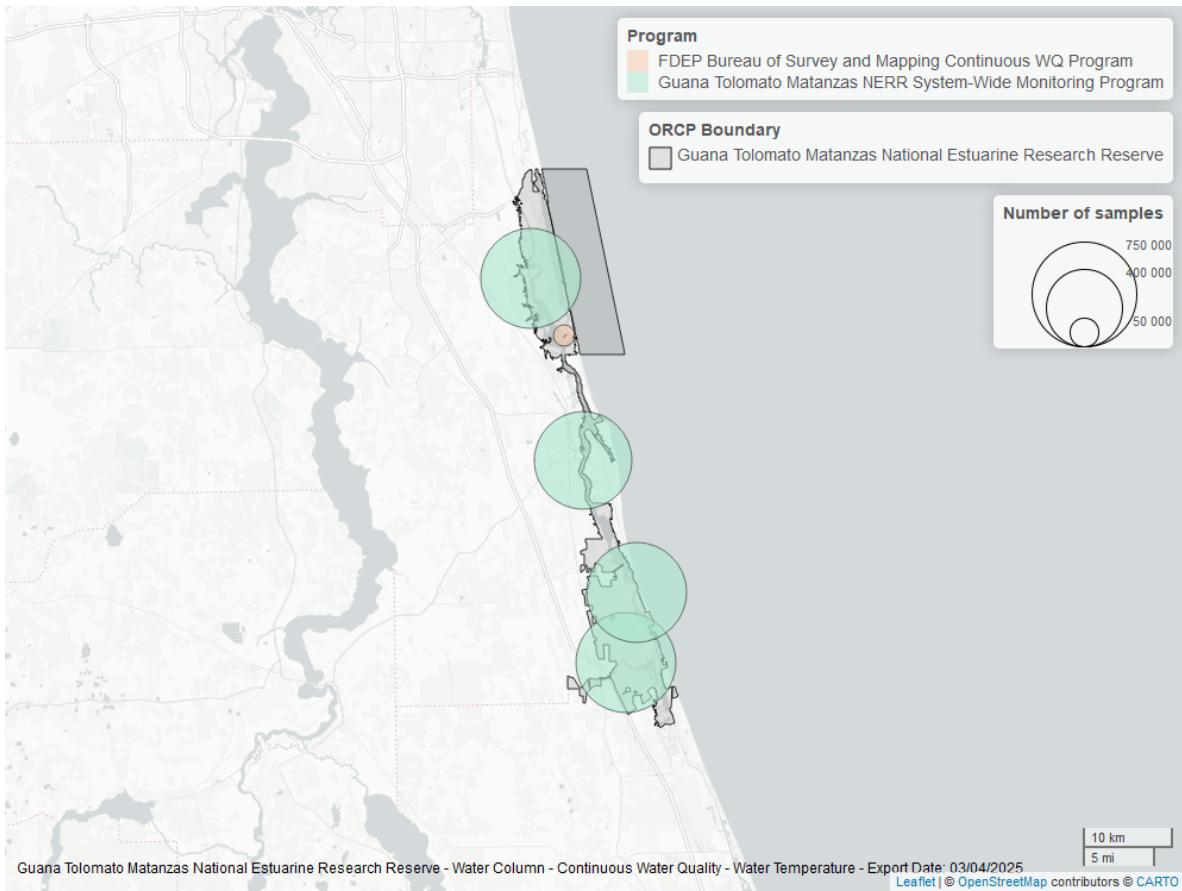


Figure 20: Map showing location of water temperature continuous water quality sampling locations within the boundaries of *Guana Tolomato Matanzas National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

pH - Discrete

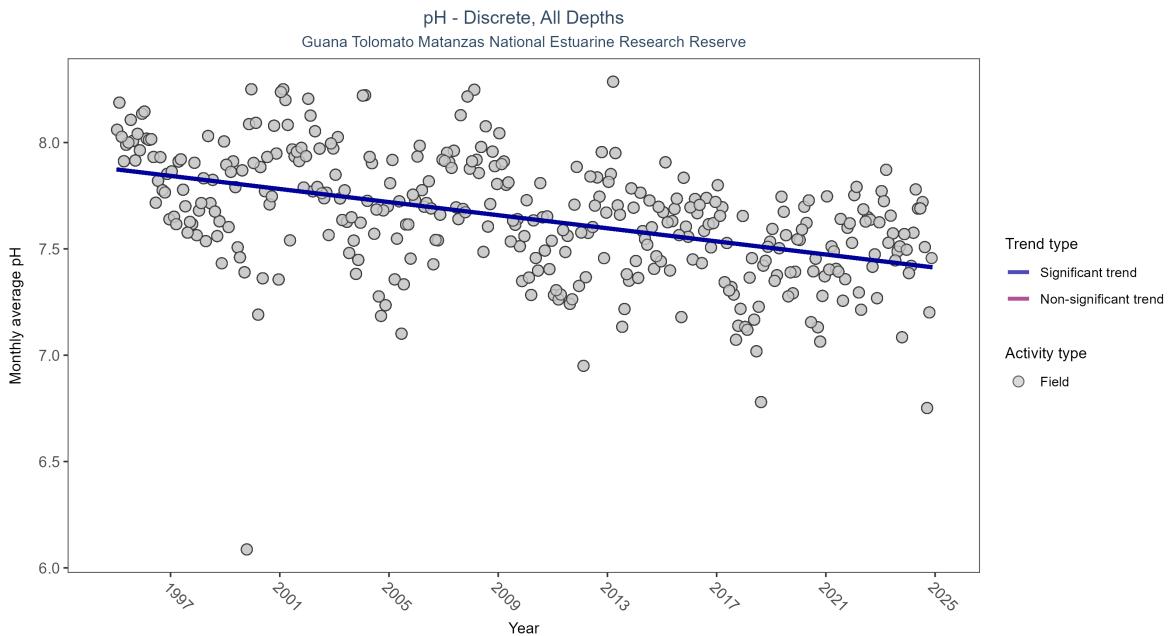


Figure 21: Scatter plot of monthly average pH over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only pH values measured in the field (circles) are included in the plot.

Table 11: Seasonal Kendall-Tau Results for - pH

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Field	Significantly decreasing trend	18686	30	1995 - 2024	7.8	-0.38982	7.87393	-0.0154	0

Monthly average pH decreased by 0.02 pH units per year.

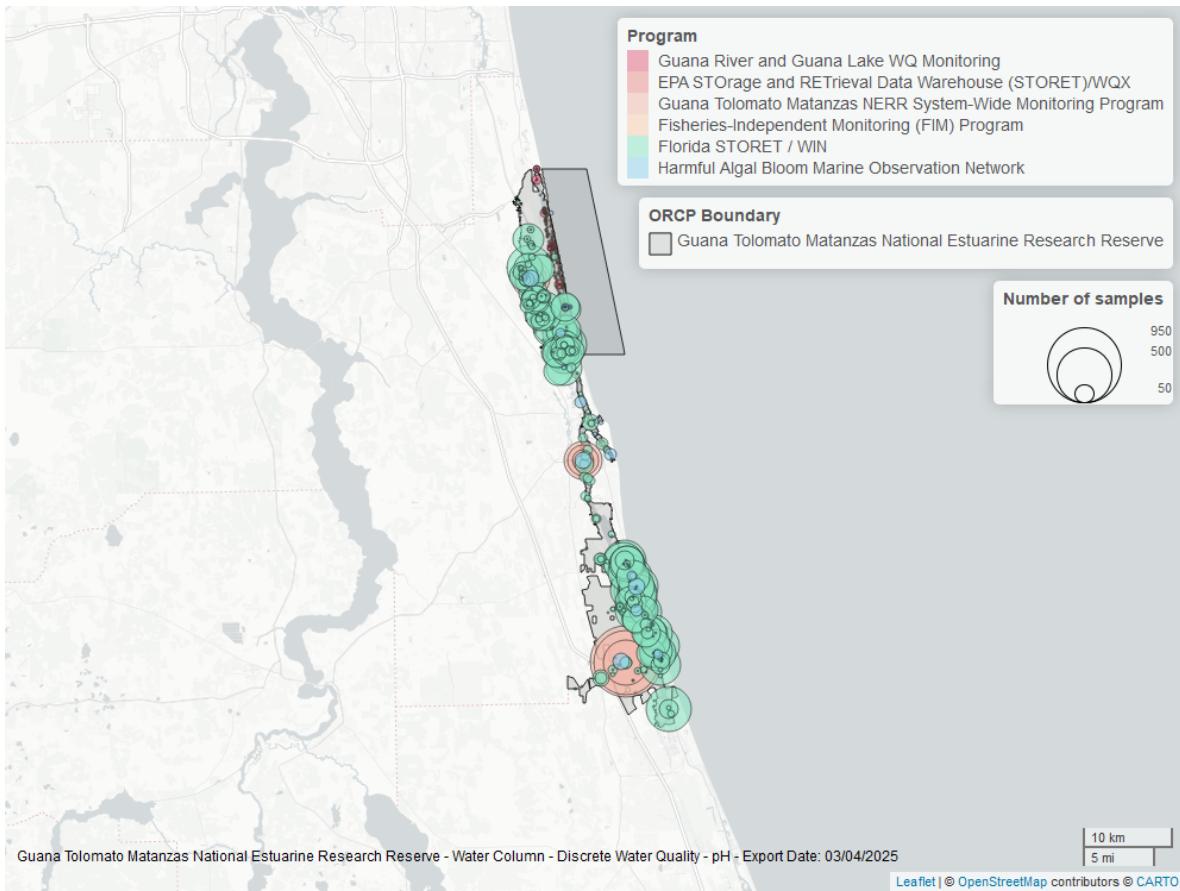


Figure 22: Map showing location of discrete water quality sampling locations within the boundaries of *Guana Tolomato Matanzas National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

pH - Continuous

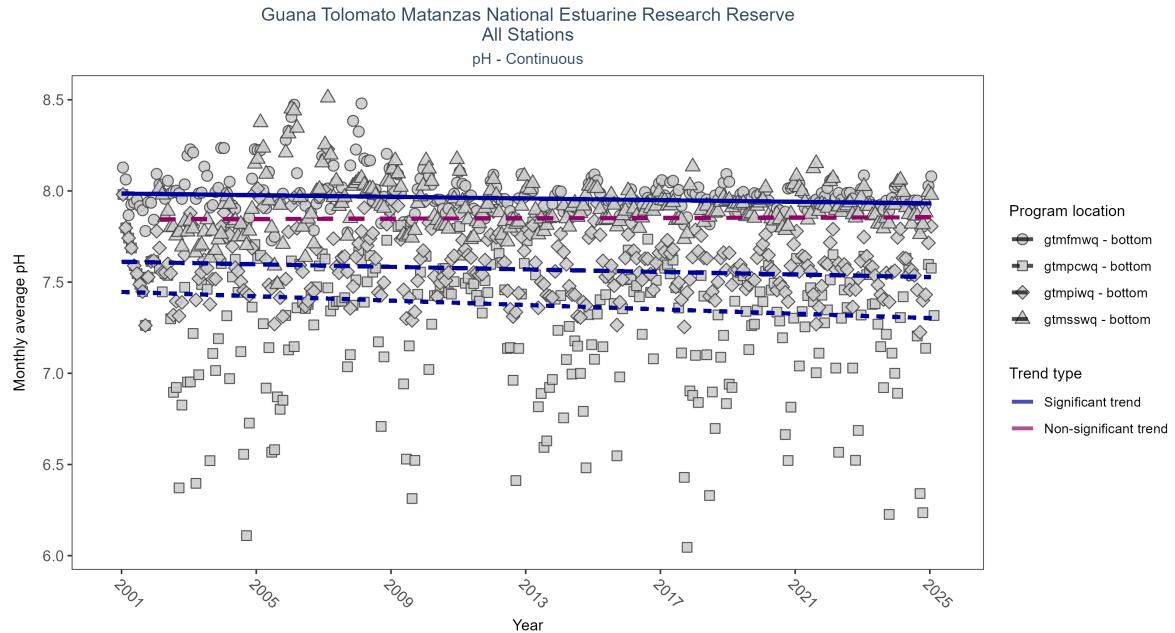


Figure 23: Scatter plot of monthly average pH over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 12: Seasonal Kendall-Tau Results - pH

Program Location	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
gtmsswq	No significant trend	637677	24	2002 - 2025	7.9	0.02	7.84	0.00	0.5521
gtmpiwq	Significantly decreasing trend	661500	25	2001 - 2025	7.6	-0.17	7.61	0.00	0.0001
gtmfmwq	Significantly decreasing trend	668566	25	2001 - 2025	8.0	-0.15	7.99	0.00	0.0003
gtmpewq	Significantly decreasing trend	696839	25	2001 - 2025	7.4	-0.12	7.45	-0.01	0.0036

At three program locations, monthly average pH decreased between less than 0.01 and 0.01 pH units per year. No detectable change in monthly average pH was observed at one location.

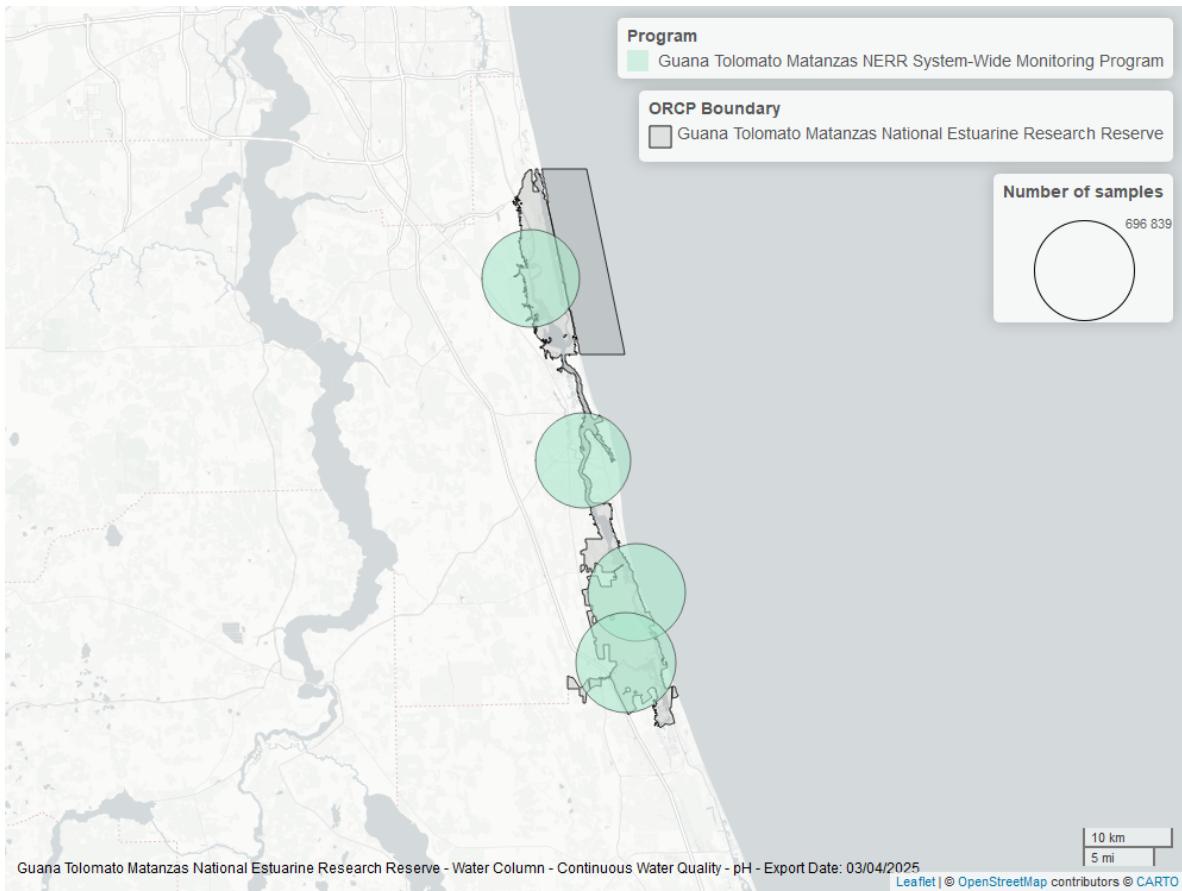


Figure 24: Map showing location of ph continuous water quality sampling locations within the boundaries of *Guana Tolomato Matanzas National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Water Clarity

Turbidity - Discrete

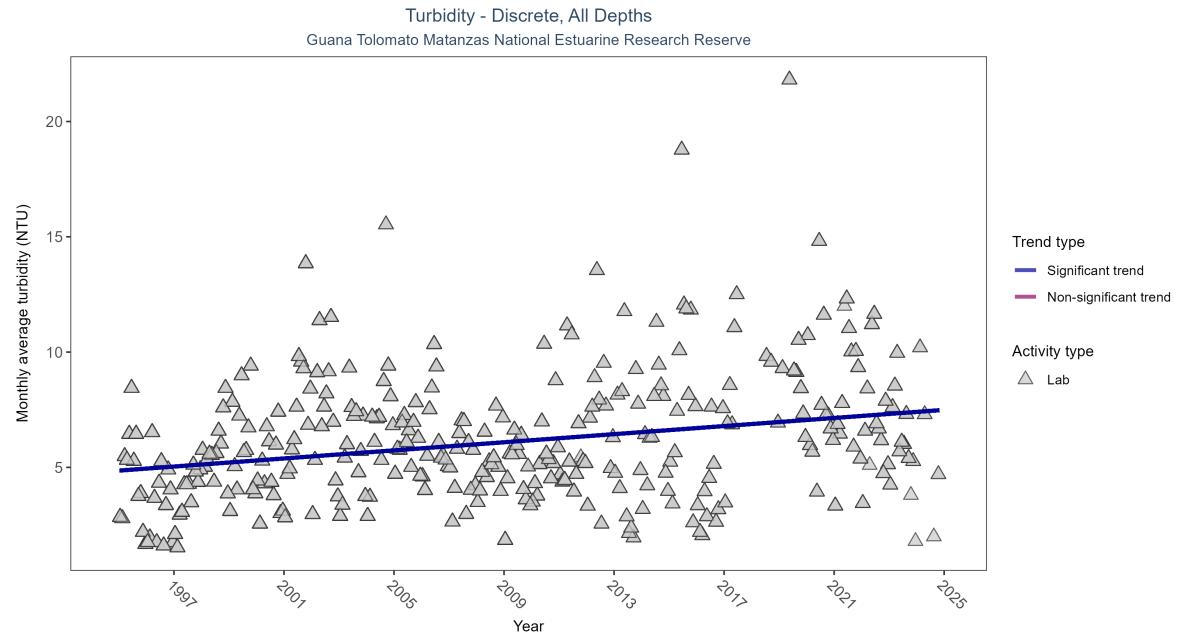


Figure 25: Scatter plot of monthly average turbidity over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only turbidity values measured in the laboratory (triangles) are included in the plot.

Table 13: Seasonal Kendall-Tau Results for - Turbidity

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Lab	Significantly increasing trend	14793	30	1995 - 2024	4.5	0.22654	4.85933	0.0878	0

Monthly average turbidity increased by 0.09 NTU per year, indicating a decrease in water clarity.

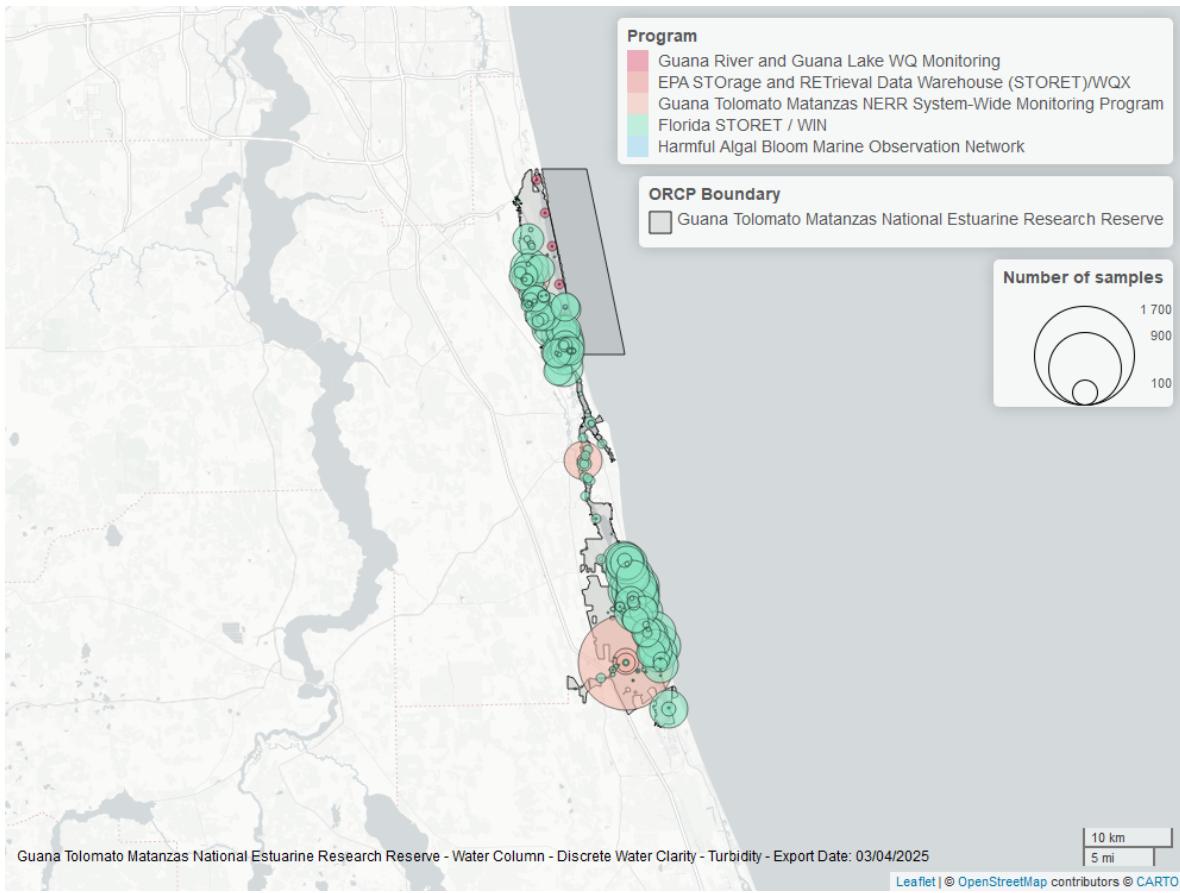


Figure 26: Map showing location of discrete water quality sampling locations within the boundaries of *Guana Tolomato Matanzas National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Turbidity - Continuous

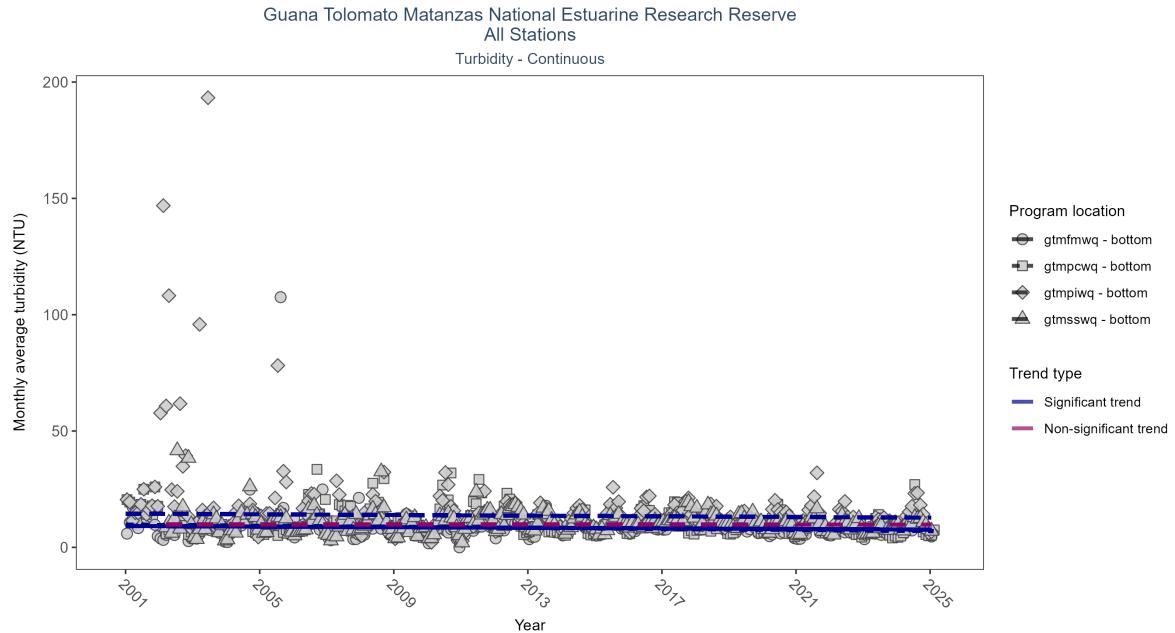


Figure 27: Scatter plot of monthly average turbidity over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 14: Seasonal Kendall-Tau Results - Turbidity

Program Location	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
gtmsswq	No significant trend	633255	24	2002 - 2025	9	0.00	9.83	0.00	0.937
gtmpiwq	Significantly decreasing trend	643280	25	2001 - 2025	10	-0.10	14.48	-0.07	0.0222
gtmfmwq	Significantly decreasing trend	680985	25	2001 - 2025	7	-0.11	9.19	-0.06	0.0073
gtmpcwq	Significantly decreasing trend	687902	25	2001 - 2025	9	-0.18	9.73	-0.11	0

At three program locations, monthly average turbidity decreased between 0.06 and 0.11 NTU per year. No detectable change in monthly average turbidity was observed at one location.

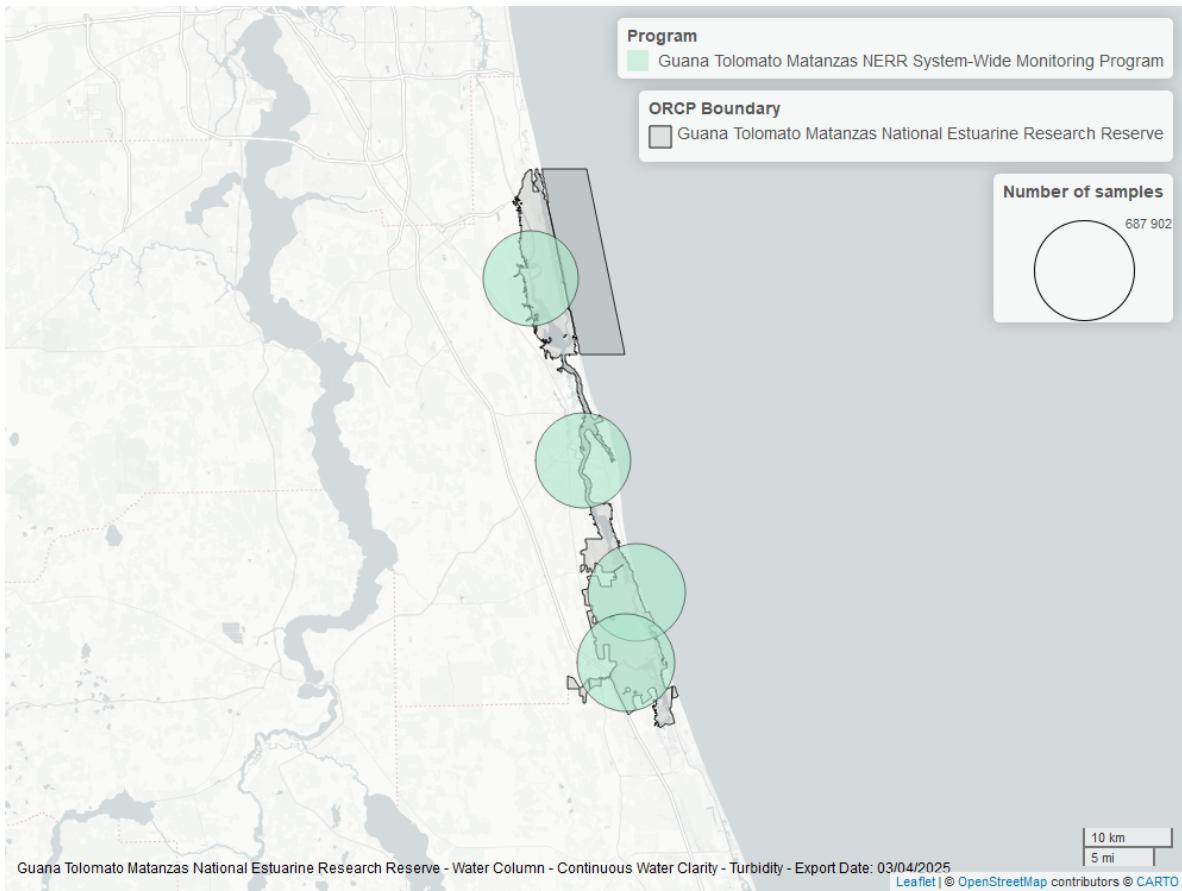


Figure 28: Map showing location of turbidity continuous water quality sampling locations within the boundaries of *Guana Tolomato Matanzas National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Total Suspended Solids - Discrete

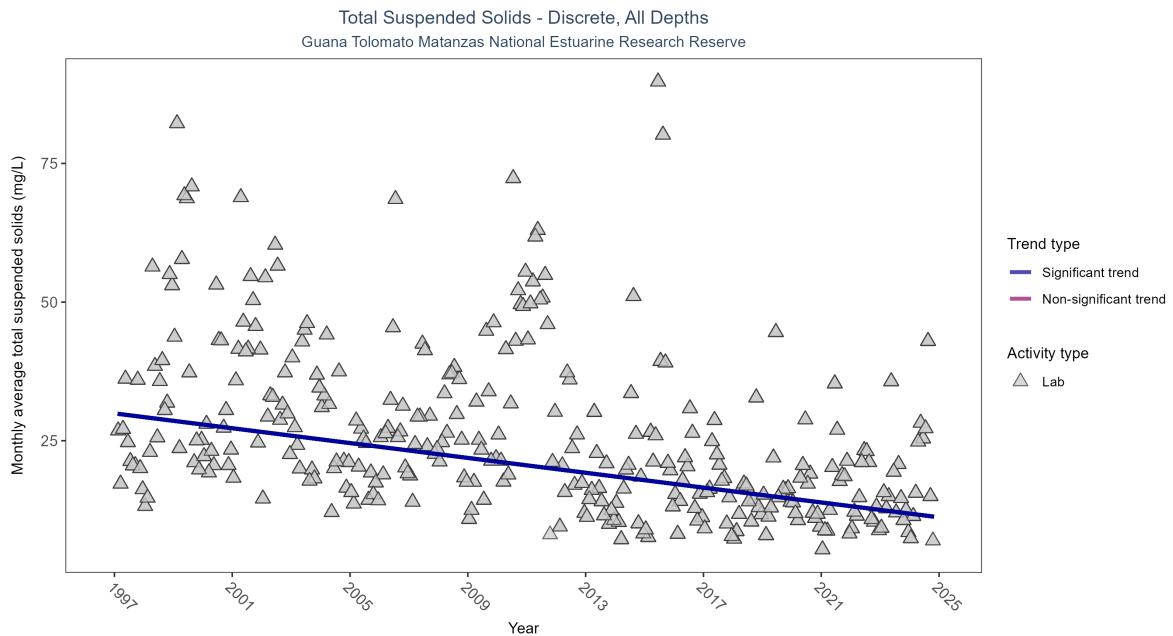


Figure 29: Scatter plot of monthly average total suspended solids (TSS) over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only TSS values obtained from laboratory analyses (triangles) are included in the plot.

Table 15: Seasonal Kendall-Tau Results for - Total Suspended Solids

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P	
Lab	Significantly decreasing trend	4982	28	1997 - 2024		17	-0.39611	29.93195	-0.66923	0

Monthly average total suspended solids decreased by 0.67 mg/L per year, indicating an increase in water clarity.

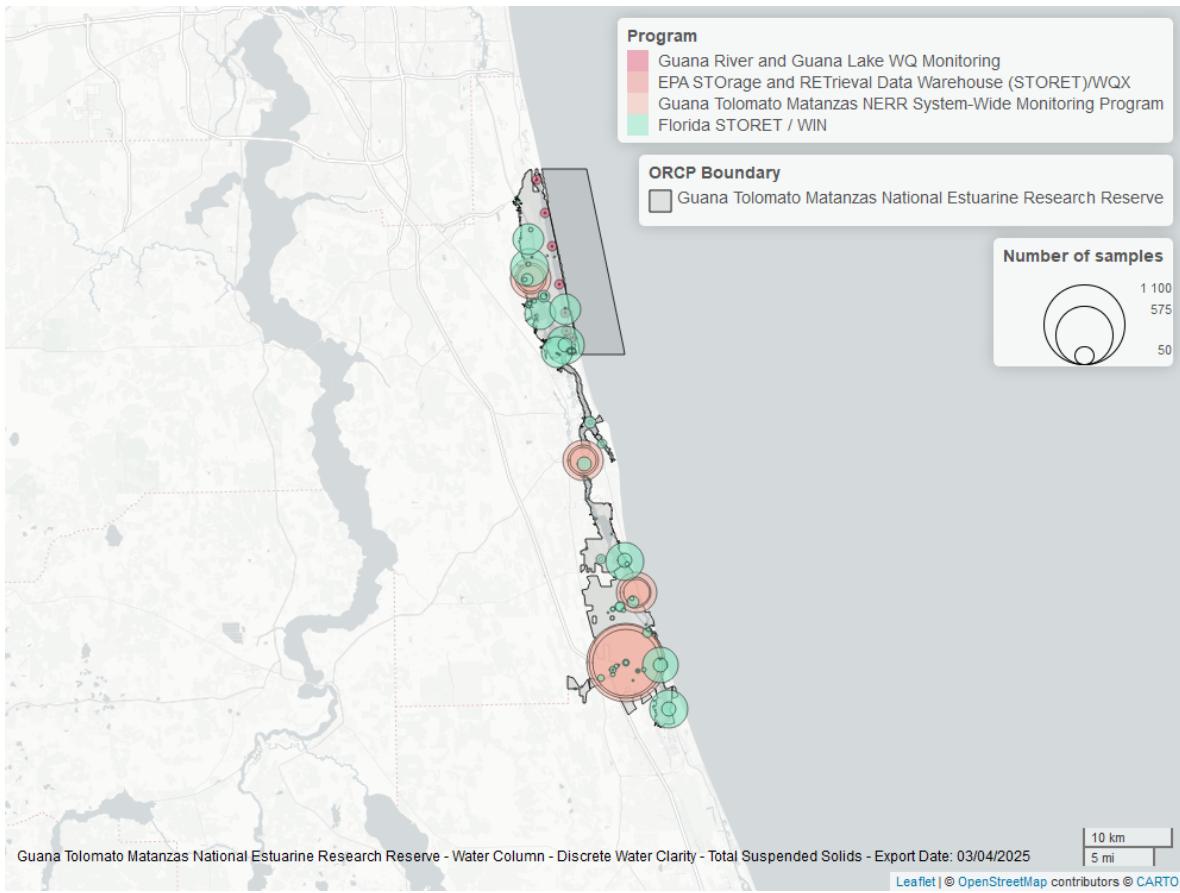


Figure 30: Map showing location of discrete water quality sampling locations within the boundaries of *Guana Tolomato Matanzas National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Chlorophyll a, Uncorrected for Pheophytin - Discrete

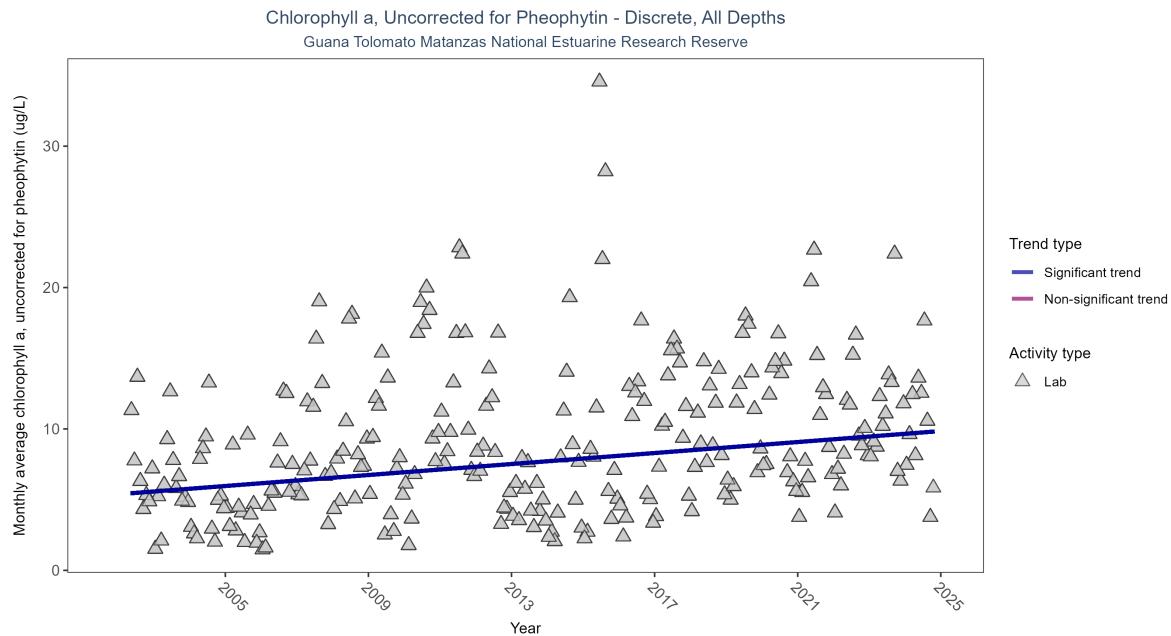


Figure 31: Scatter plot of monthly average levels of chlorophyll a, uncorrected for pheophytin, over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed chlorophyll a (triangles) is included in the plot.

Table 16: Seasonal Kendall-Tau Results for - Chlorophyll a, Uncorrected for Pheophytin

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Lab	Significantly increasing trend	6317	23	2002 - 2024	6.2	0.25387	5.38207	0.19431	0

Monthly average chlorophyll a, uncorrected for pheophytin, increased by $0.19 \mu\text{g/L}$ per year, indicating a decrease in water clarity.

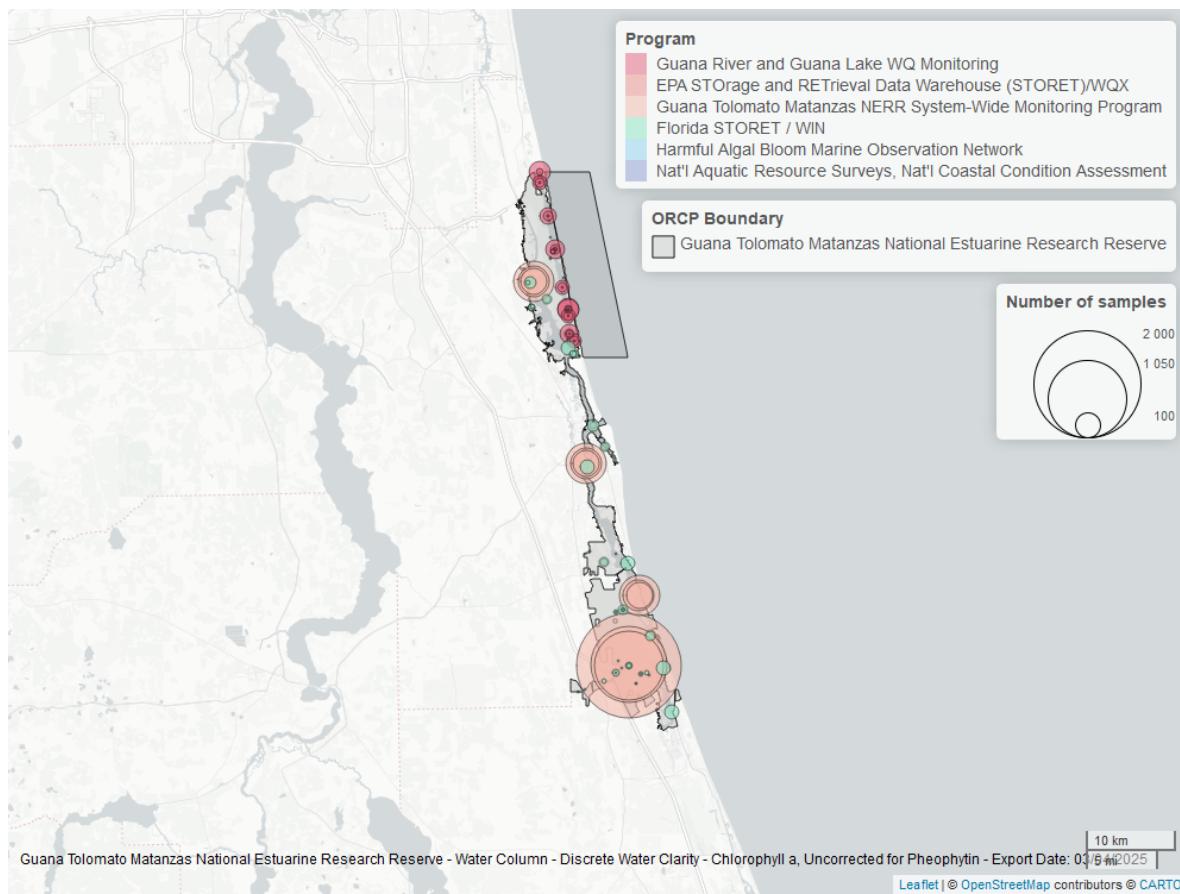


Figure 32: Map showing location of discrete water quality sampling locations within the boundaries of *Guana Tolomato Matanzas National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Chlorophyll a, Corrected for Pheophytin - Discrete

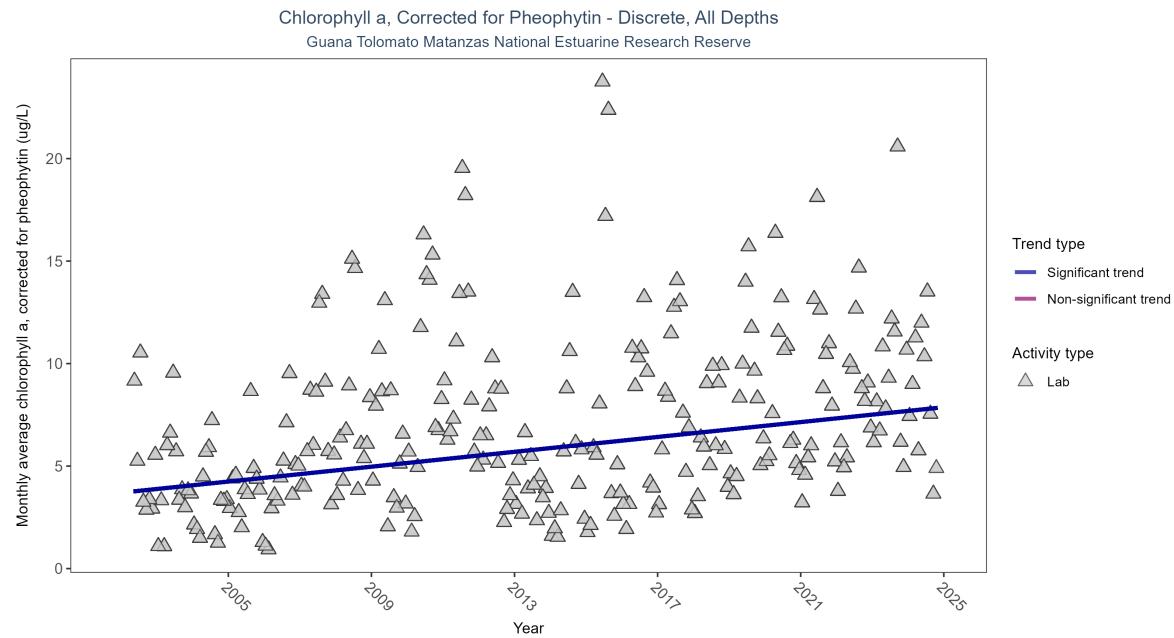


Figure 33: Scatter plot of monthly average levels of chlorophyll a, corrected for pheophytin, over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed chlorophyll a (triangles) is included in the plot.

Table 17: Seasonal Kendall-Tau Results for - Chlorophyll a, Corrected for Pheophytin

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Lab	Significantly increasing trend	7993	23	2002 - 2024	4.7	0.29681	3.70111	0.18133	0

Monthly average chlorophyll a, corrected for pheophytin, increased by 0.18 $\mu\text{g}/\text{L}$ per year, indicating a decrease in water clarity.

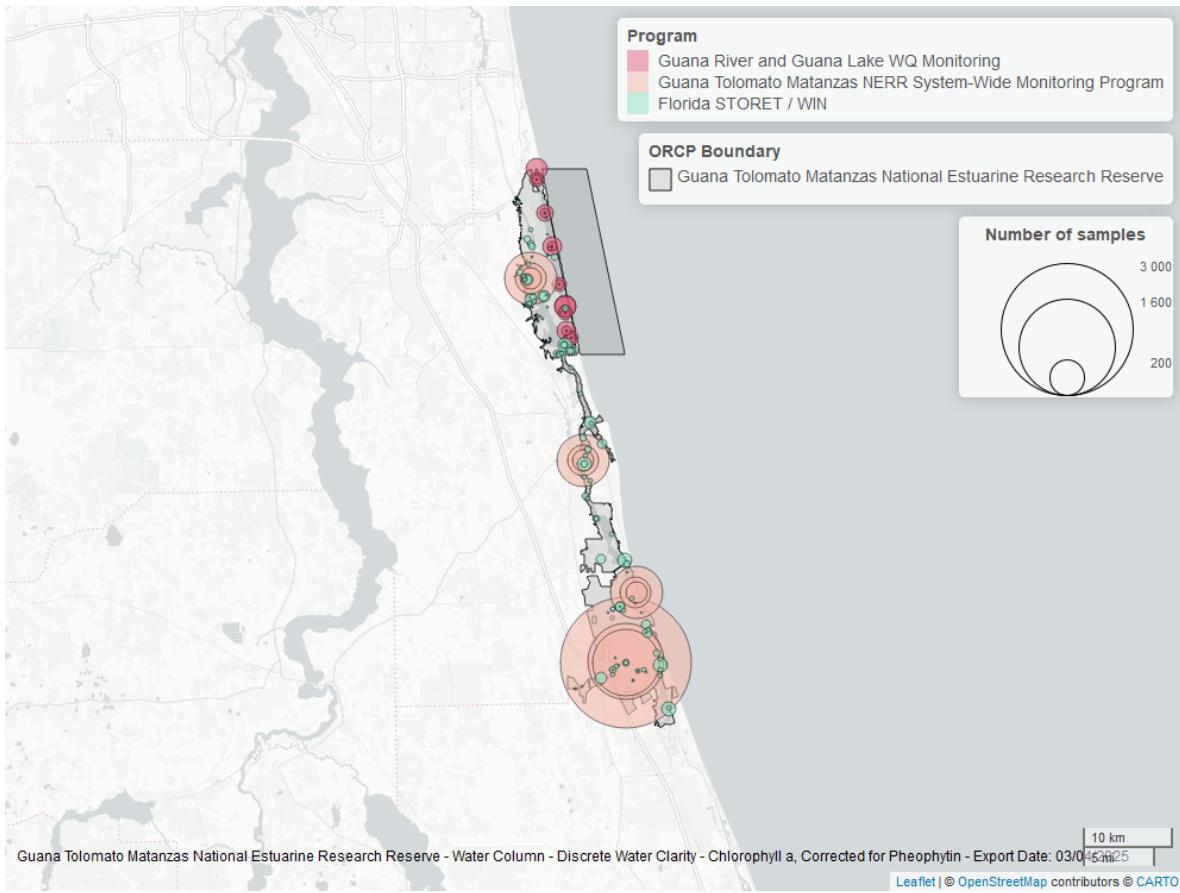


Figure 34: Map showing location of discrete water quality sampling locations within the boundaries of *Guana Tolomato Matanzas National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Secchi Depth - Discrete

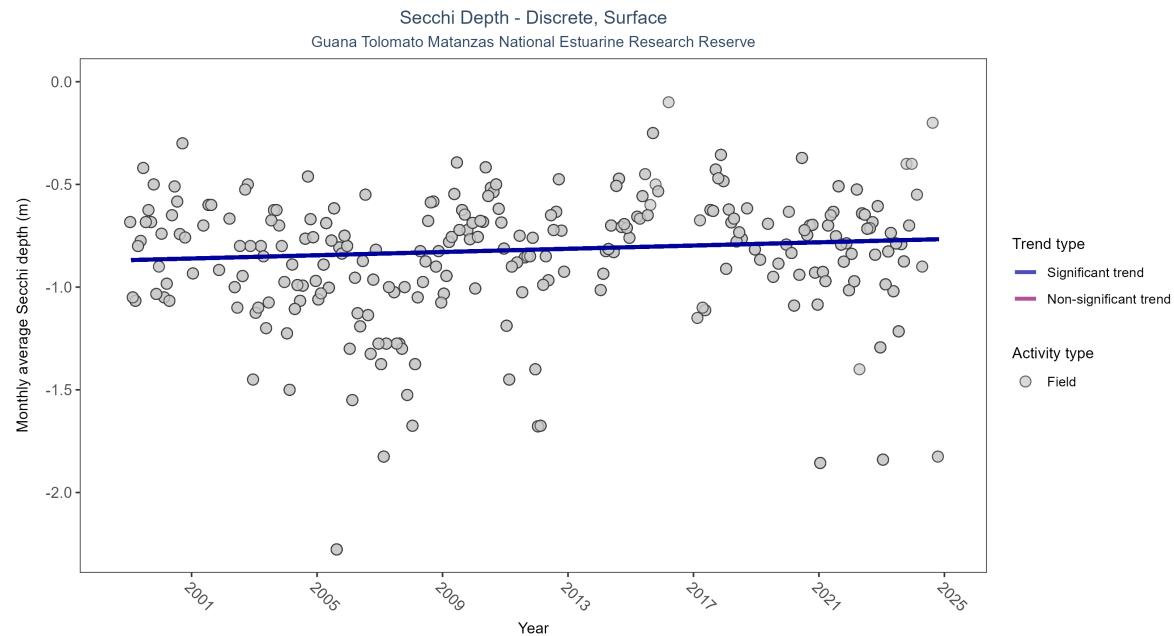


Figure 35: Scatter plot of monthly average Secchi depth over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Secchi depth is only measured in the field (circles).

Table 18: Seasonal Kendall-Tau Results for - Secchi Depth

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Field	Significantly increasing trend	2870	25	1999 - 2024	-0.8	0.09635	-0.86855	0.00394	0.0436

Monthly average Secchi depth became shallower by less than 0.01 m per year, indicating a decrease in water clarity.

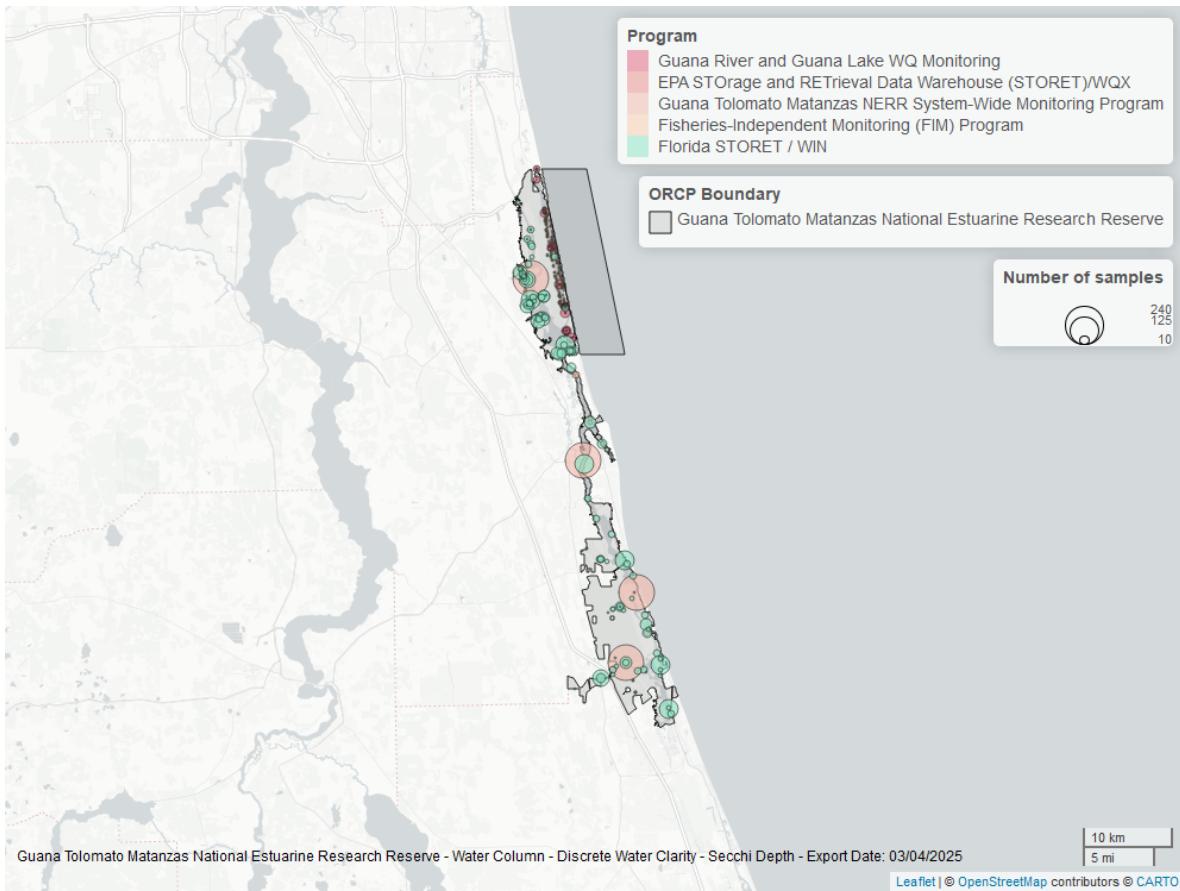


Figure 36: Map showing location of discrete water quality sampling locations within the boundaries of *Guana Tolomato Matanzas National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Colored Dissolved Organic Matter - Discrete

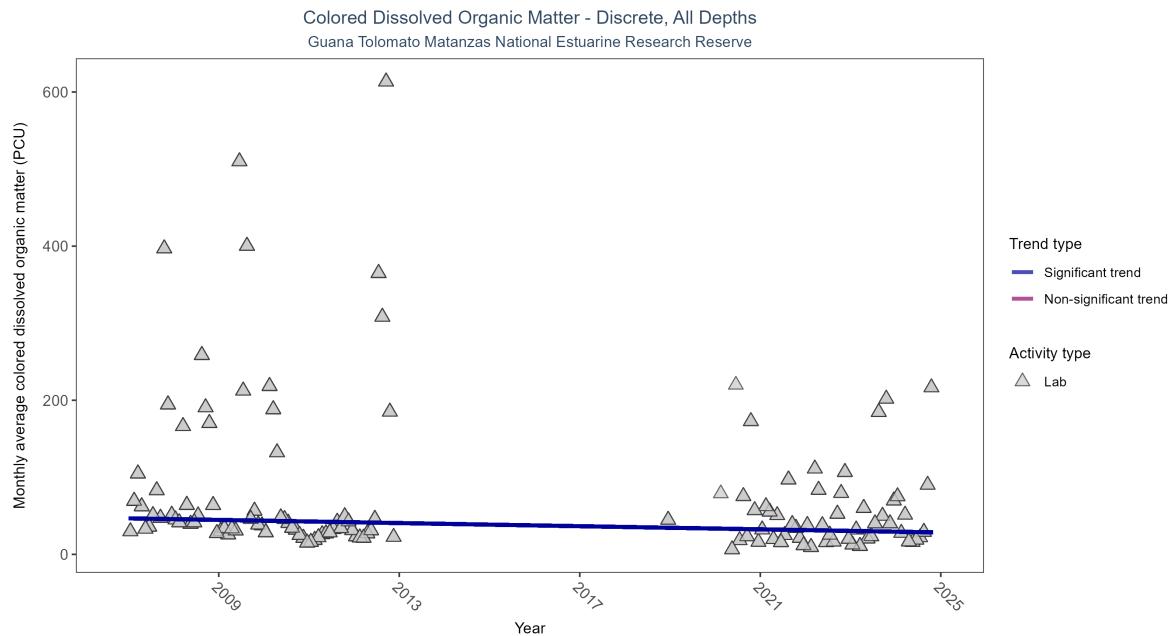


Figure 37: Scatter plot of monthly average colored dissolved organic matter (CDOM) over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed CDOM (triangles) is included in the plot.

Table 19: Seasonal Kendall-Tau Results for - Colored Dissolved Organic Matter

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median Result Value	Tau	Sen Intercept	Sen Slope	P
Lab	Significantly decreasing trend	1826	12	2007 - 2024	33.4	-0.18985	46.72978	-1.01726	0.0064

Monthly average colored dissolved organic matter decreased by 1.02 PCU per year, indicating an increase in water clarity.

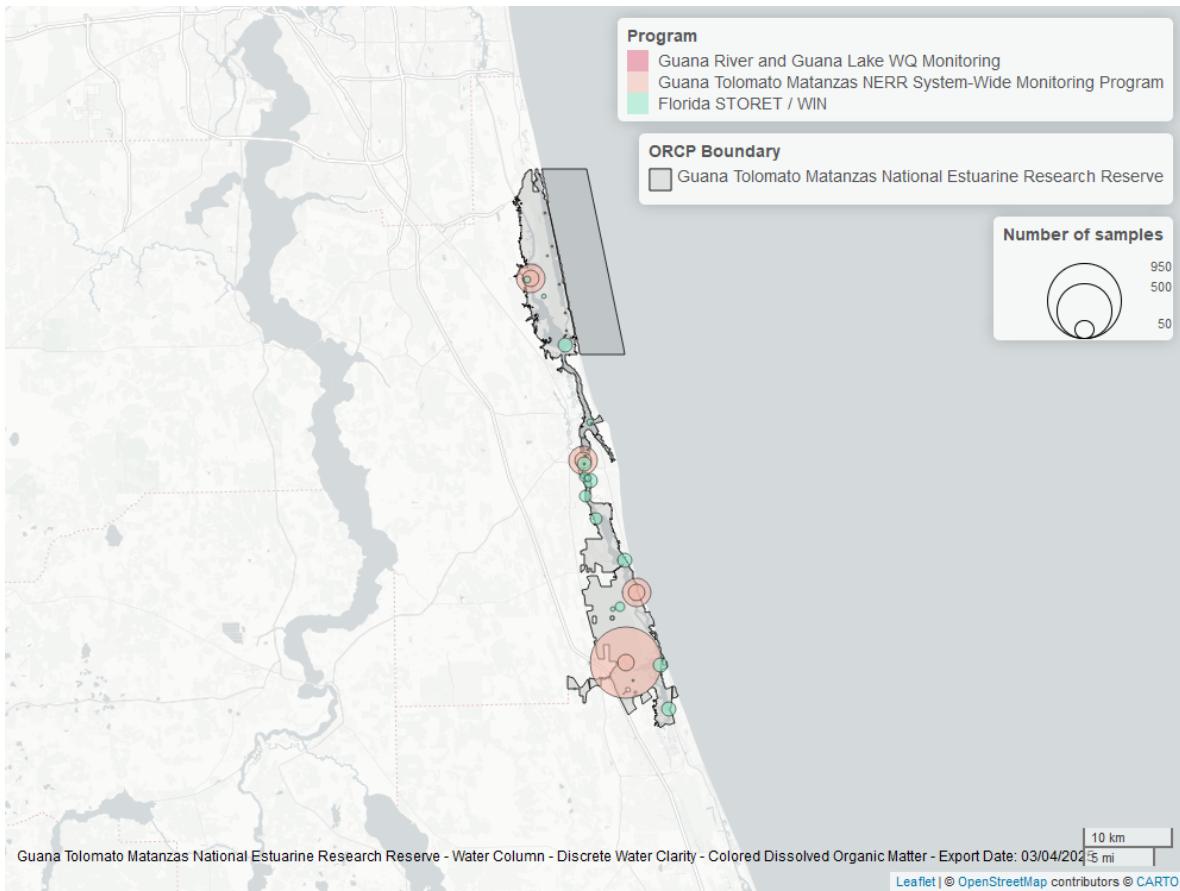


Figure 38: Map showing location of discrete water quality sampling locations within the boundaries of *Guana Tolomato Matanzas National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.