Guana River Marsh Aquatic Preserve

SEACAR Habitat Analyses

Last compiled on 02 July, 2025

Contents

Funding & Acknowledgements

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Threshold Filtering

Threshold filters, following the guidance of Florida Department of Environmental Protection's (*FDEP*) Division of Environmental Assessment and Restoration (*DEAR*) are used to exclude specific results values from the SEACAR Analysis. Based on the threshold filters, Quality Assurance / Quality Control (*QAQC*) Flags are inserted into the *SEACAR_QAQCFlagCode* and *SEACAR_QAQC_Description* columns of the export data. The *Include* column indicates whether the *QAQC* Flag will also indicate that data are excluded from analysis. No data are excluded from the data export, but the analysis scripts can use the *Include* column to exclude data (1 to include, 0 to exclude).

Table 1: Continuous Water Quality threshold values

Parameter Name	*Units*	*Low Threshold*	*High Threshold*
Dissolved Oxygen	mg/L	-0.000001	50
Dissolved Oxygen Saturation	%	-0.000001	500
Salinity	ppt	-0.000001	70
Turbidity	NTU	-0.000001	4000
Water Temperature	Degrees C	-5.000000	45
pH	None	2.000000	14

Table 2: Discrete Water Quality threshold values

Parameter Name	*Units*	*Low Threshold*	*High Threshold*
Ammonia, Un-ionized (NH3)	mg/L	-	-
Ammonium, Filtered (NH4)	mg/L	-	-
Chlorophyll a, Corrected for Pheophytin	ug/L	-	-
Chlorophyll a, Uncorrected for Pheophytin	ug/L	-	-
Colored Dissolved Organic Matter	PCU	-	-

Parameter Name	*Units*	*Low Threshold*	*High Threshold*
Dissolved Oxygen	mg/L	-0.000001	25
Dissolved Oxygen Saturation	%	-0.000001	310
Fluorescent Dissolved Organic Matter	QSE	-	-
Light Extinction Coefficient	mˆ-1	-	-
NO2+3, Filtered	mg/L	-	-
Nitrate (NO3)	mg/L	-	-
Nitrite (NO2)	mg/L	-	-
Nitrogen, organic	mg/L	-	-
Phosphate, Filtered (PO4)	mg/L	-	-
Salinity	ppt	-0.000001	70
Secchi Depth	m	0.000001	50
Specific Conductivity	mS/cm	0.005000	100
Total Kjeldahl Nitrogen	mg/L	-	-
Total Nitrogen	mg/L	-	-
Total Nitrogen	mg/L	-	-
Total Phosphorus	mg/L	-	-
Total Suspended Solids	mg/L	-	-
Turbidity	NTU	-	-
Water Temperature	Degrees C	3.000000	40
pH	None	2.000000	13

Table 3: Quality Assurance Flags inserted based on threshold checks listed in Table 1 and 2

SEACAR QAQC Description	*Include*	*SEACAR QAQCFlagCode*
Exceeds maximum threshold	0	2Q
Below minimum threshold	0	4Q
Within threshold tolerance	1	6Q
No defined thresholds for this parameter	1	7Q

Value Qualifiers

Value qualifier codes included within the data are used to exclude certain results from the analysis. The data are retained in the data export files, but the analysis uses the *Include* column to filter the results.

STORET and WIN value qualifier codes

Value qualifier codes from *STORET* and *WIN* data are examined with the database and used to populate the *Include* column in data exports.

Table 4: Value Qualifier codes excluded from analysis

Qualifier Source	*Value Qualifier*	*Include*	*MDL*	*Description*
STORET-WIN	H	0	0	Value based on field kit determination; results may not be accurate
STORET-WIN	J	0	0	Estimated value
STORET-WIN	V	0	0	Analyte was detected at or above method detection limit
STORET-WIN	Y	0	0	Lab analysis from an improperly preserved sample; data may be inaccurate

Discrete Water Quality Value Qualifiers

The following value qualifiers are highlighted in the Discrete Water Quality section of this report. An exception is made for **Program 476** - *Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network* and data flagged with Value Qualifier **H** are included for this program only.

H - Value based on field kit determiniation; results may not be accurate. This code shall be used if a field screening test (e.g., field gas chromatograph data, immunoassay, or vendor-supplied field kit) was used to generate the value and the field kit or method has not been recognized by the Department as equivalent to laboratory methods.

I - The reported value is greater than or equal to the laboratory method detection limit but less than the laboratory practical quantitation limit.

Q - Sample held beyond the accepted holding time. This code shall be used if the value is derived from a sample that was prepared or analyzed after the approved holding time restrictions for sample preparation or analysis.

S - Secchi disk visible to bottom of waterbody. The value reported is the depth of the waterbody at the location of the Secchi disk measurement.

U - Indicates that the compound was analyzed for but not detected. This symbol shall be used to indicate that the specified component was not detected. The value associated with the qualifier shall be the laboratory method detection limit. Unless requested by the client, less than the method detection limit values shall not be reported

Systemwide Monitoring Program (SWMP) value qualifier codes

Value qualifier codes from the *SWMP* continuous program are examined with the database and used to populate the *Include* column in data exports. *SWMP* Qualifier Codes are indicated by *QualifierSource=SWMP*.

Table 5: SWMP Value Qualifier codes

Qualifier Source	*Value Qualifier*	*Include*	*Description*
SWMP	-1	1	Optional parameter not collected
SWMP	-2	0	Missing data
SWMP	-3	0	Data rejected due to QA/QC
SWMP	-4	0	Outside low sensor range
SWMP	-5	0	Outside high sensor range
SWMP	0	1	Passed initial QA/QC checks
SWMP	1	0	Suspect data
SWMP	2	1	Reserved for future use
SWMP	3	1	Calculated data: non-vented depth/level sensor correction for changes in barometric pressure
SWMP	4	1	Historical: Pre-auto QA/QC
SWMP	5	1	Corrected data

Water Column

The water column habitat extends from the water's surface to the bottom sediments, and it's where fish, dolphins, crabs and people swim! So much life makes its home in the water column that the health of marine and coastal ecosystems, as well as human economies, depend on the condition of this vulnerable habitat. Local patterns of rainfall, temperature, winds and currents can rapidly change the condition of the water column, while global influences such as El Niño/La Niña, large-scale fluctuation in sea temperatures and climate change can have long-term effects. Inputs from the prosperity of our day-to-day lives including farming, mining and forestry, and emissions from power generation, automobiles and water treatment can also alter the health of the water column. Acting alone or together, each input can have complex and lasting effects on habitats and ecosystems.

SEACAR evaluates water column health with several essential parameters. These include nutrient surveys of nitrogen and phosphorus, and water quality assessments of salinity, dissolved oxygen, pH, and water temperature. Water clarity is evaluated with Secchi depth, turbidity, levels of chlorophyll a, total suspended solids, and colored dissolved organic matter. Additionally, the richness of nekton is indicated by the abundance of free-swimming fishes and macroinvertebrates like crabs and shrimps.

Seasonal Kendall-Tau Analysis

Indicators must have a minimum of five to ten years, depending on the habitat, of data within the geographic range of the analysis to be included in the analysis. Ten years of data are required for discrete parameters, and five years of data are required for continuous parameters. If there are insufficient years of data, the number of years of data available will be noted and labeled as "insufficient data to conduct analysis". Further, for the preferred Seasonal Kendall-Tau test, there must be data from at least two months in common across at least two consecutive years within the RCP managed area being analyzed. Values that pass both of these tests will be included in the analysis and be labeled as *Use_In_Analysis* = **TRUE**. Any that fail either test will be excluded from the analyses and labeled as *Use_In_Analysis* = **FALSE**. The points for all Water Column plots displayed in this section are monthly averages. Trend significance will be denoted as "Significant Trend" (when $p < 0.05$), or "Non-significant Trend" (when $p >= 0.05$). Any parameters with insufficient data to perform Seasonal Kendall-Tau test will have their monthly averages plotted without a corresponding trend line.

Water Quality - Discrete

The following files were used in the discrete analysis:

- *Combined_WQ_WC_NUT_Chlorophyll_a_corrected_for_pheophytin-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_Chlorophyll_a_uncorrected_for_pheophytin-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_Colored_dissolved_organic_matter_CDOM-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_Dissolved_Oxygen-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_Dissolved_Oxygen_Saturation-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_pH-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_Salinity-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_Secchi_Depth-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_Total_Nitrogen-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_Total_Phosphorus-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_Total_Suspended_Solids_TSS-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_Turbidity-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_Water_Temperature-2025-Mar-06.txt*

Chlorophyll a, Corrected for Pheophytin - Discrete

Seasonal Kendall-Tau Trend Analysis

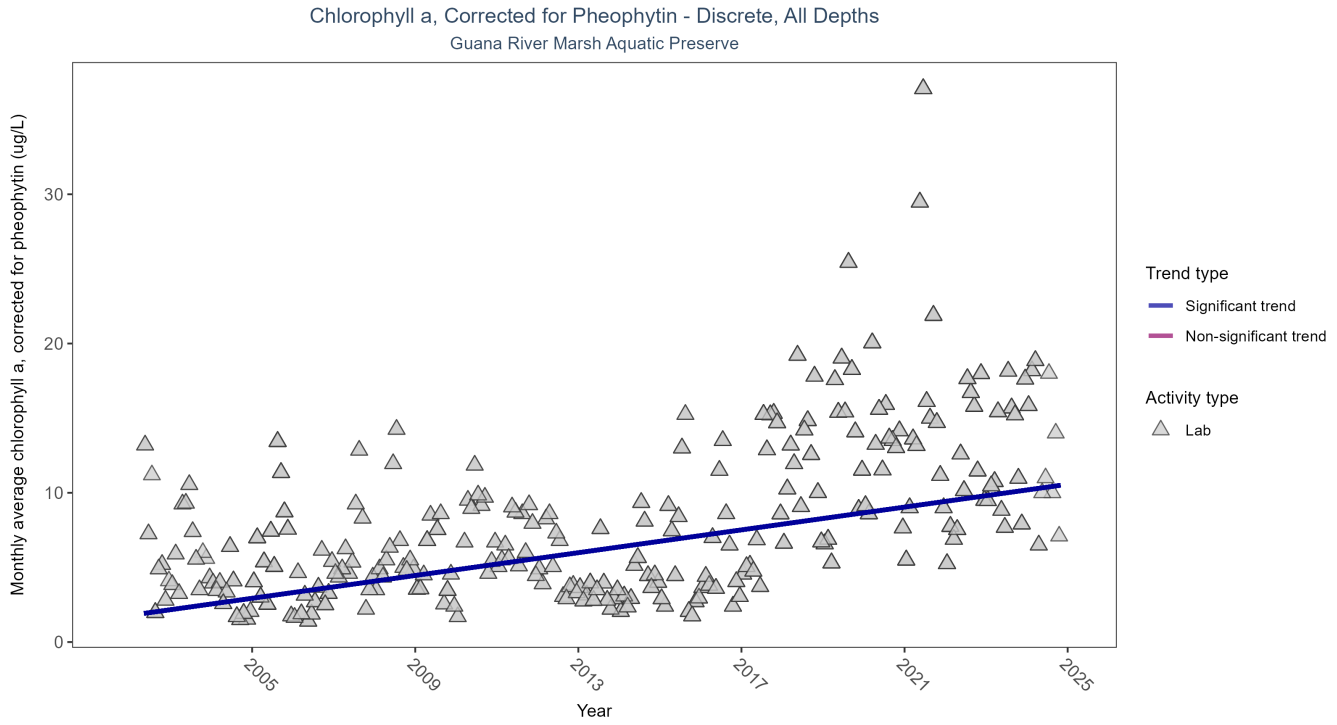

Figure 1: Scatter plot of monthly average levels of chlorophyll a, corrected for pheophytin, over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed chlorophyll a (triangles) is included in the plot.

Table 6: Seasonal Kendall-Tau Trend Analysis for Chlorophyll a, Corrected for Pheophytin

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Lab	Significantly increasing trend	1635	23	2002 - 2024	5.4	0.4295	1.7862	0.3819	0

Monthly average chlorophyll a, corrected for pheophytin, increased by 0.38 µg/L per year, indicating a decrease in water clarity.

Figure 2: Map showing location of discrete water quality sampling locations within the boundaries of *Guana River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 7: Programs contributing data for Chlorophyll a, Corrected for Pheophytin

ProgramID	*N_Data*	*YearMin*	*YearMax*
4054	718	2002	2024
5014	588	2017	2024
5002	355	2002	2024

Program names:

4054 - Guana Tolomato Matanzas National Estuarine Research Reserve System-Wide Monitoring Program[1]
5002 - Florida STORET / WIN[2]
5014 - Guana River and Guana Lake Water Quality Monitoring[3]

Chlorophyll a, Uncorrected for Pheophytin - Discrete

Seasonal Kendall-Tau Trend Analysis

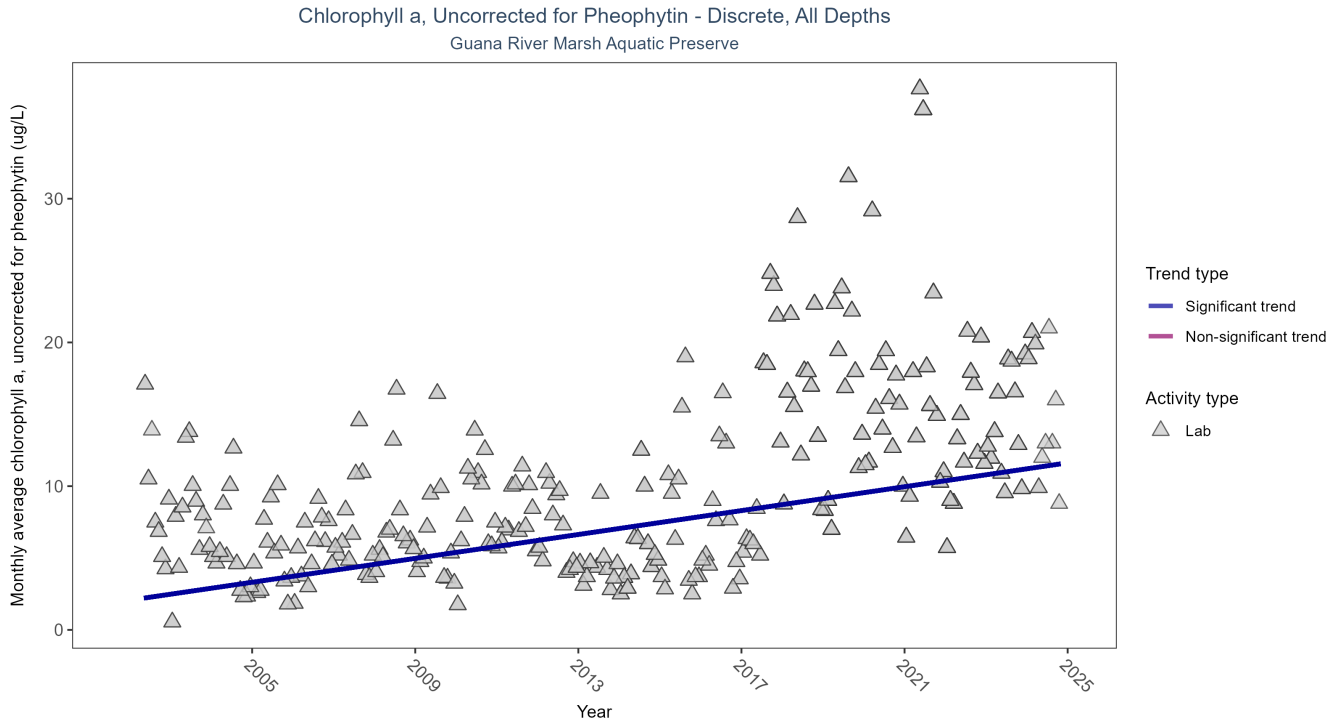

Figure 3: Scatter plot of monthly average levels of chlorophyll a, uncorrected for pheophytin, over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed chlorophyll a (triangles) is included in the plot.

Table 8: Seasonal Kendall-Tau Trend Analysis for Chlorophyll a, Uncorrected for Pheophytin

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Lab	Significantly increasing trend	1314	23	2002 - 2024	7.75	0.4077	2.0671	0.4154	0

Monthly average chlorophyll a, uncorrected for pheophytin, increased by 0.42 µg/L per year, indicating a decrease in water clarity.

Figure 4: Map showing location of discrete water quality sampling locations within the boundaries of *Guana River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 9: Programs contributing data for Chlorophyll a, Uncorrected for Pheophytin

ProgramID	*N_Data*	*YearMin*	*YearMax*
5014	636	2017	2024
4054	588	2002	2024
5002	121	2019	2024
103	40	2021	2021
95	1	2012	2012
118	1	2006	2006

Program names:

95 - Harmful Algal Bloom Marine Observation Network[4]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[5]
118 - National Aquatic Resource Surveys, National Coastal Condition Assessment[6]
4054 - Guana Tolomato Matanzas National Estuarine Research Reserve System-Wide Monitoring Program[1]
5002 - Florida STORET / WIN[2]
5014 - Guana River and Guana Lake Water Quality Monitoring[3]

Colored Dissolved Organic Matter - Discrete

Seasonal Kendall-Tau Trend Analysis

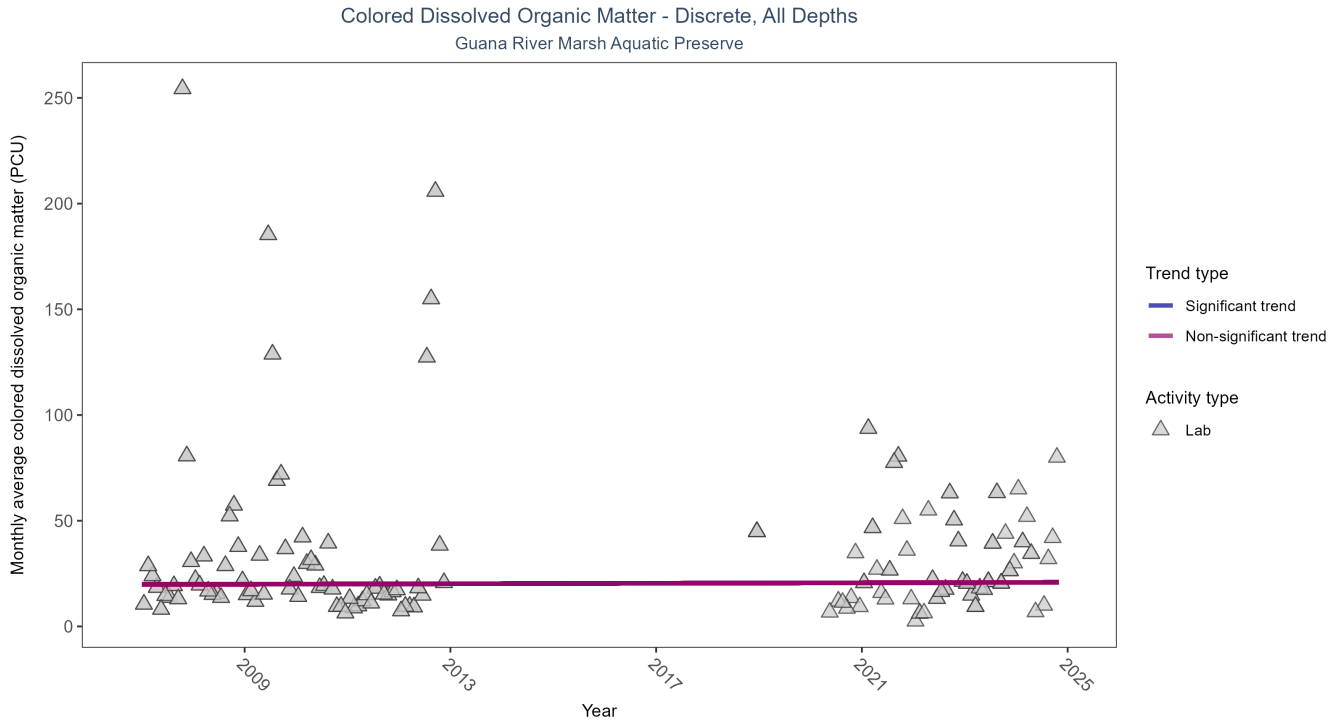

Figure 5: Scatter plot of monthly average colored dissolved organic matter (CDOM) over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed CDOM (triangles) is included in the plot.

Table 10: Seasonal Kendall-Tau Trend Analysis for Colored Dissolved Organic Matter

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Lab	No significant trend	236	12	2007 - 2024	19.5	0.0085	19.8503	0.0567	0.9025

Colored dissolved organic matter showed no detectable trend between 2007 and 2024.

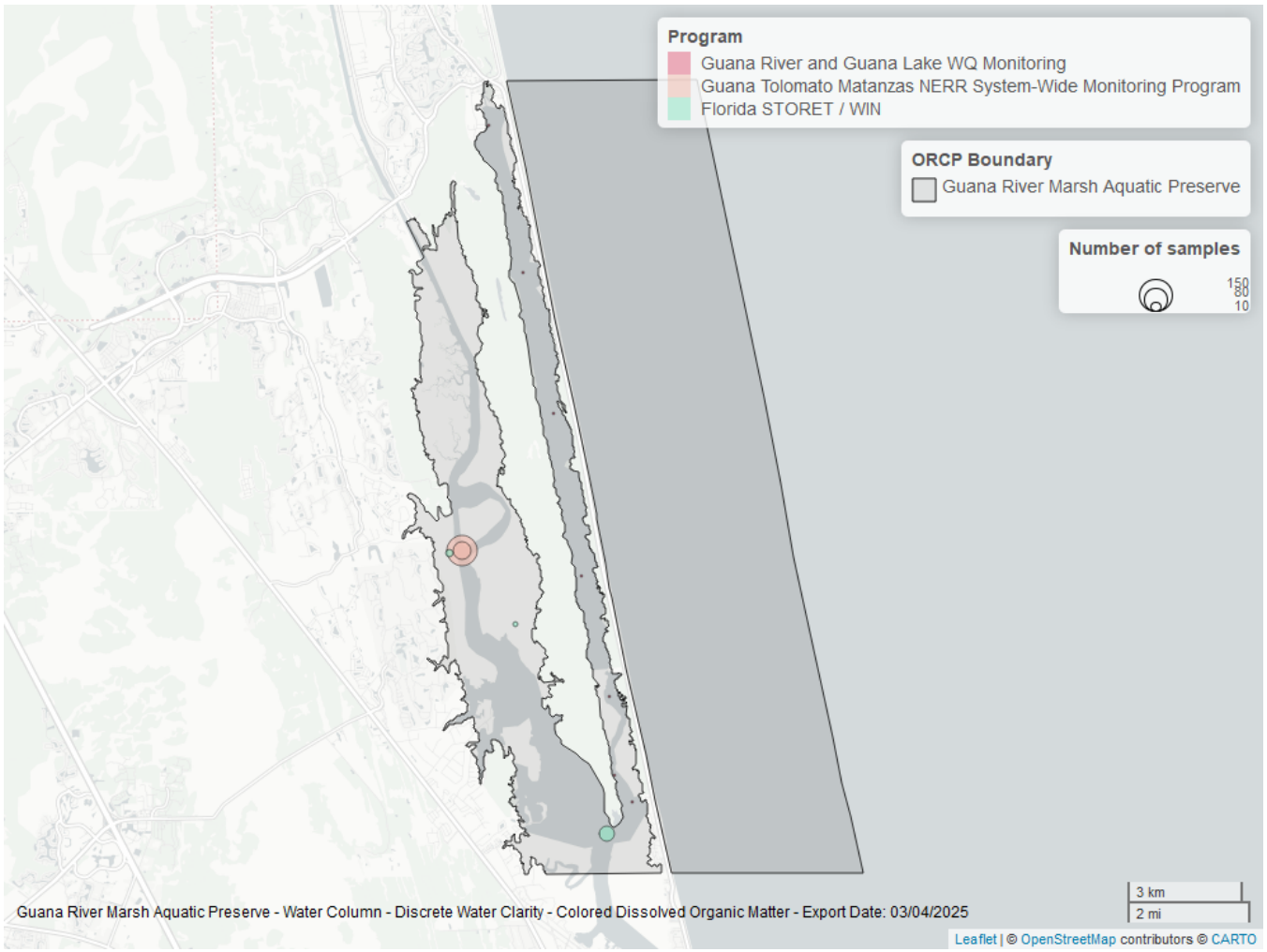

Figure 6: Map showing location of discrete water quality sampling locations within the boundaries of *Guana River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 11: Programs contributing data for Colored Dissolved Organic Matter

ProgramID	*N_Data*	*YearMin*	*YearMax*
4054	186	2007	2024
5002	44	2020	2024
5014	7	2018	2018

Program names:

4054 - Guana Tolomato Matanzas National Estuarine Research Reserve System-Wide Monitoring Program[1]
5002 - Florida STORET / WIN[2]
5014 - Guana River and Guana Lake Water Quality Monitoring[3]

Dissolved Oxygen - Discrete

Seasonal Kendall-Tau Trend Analysis

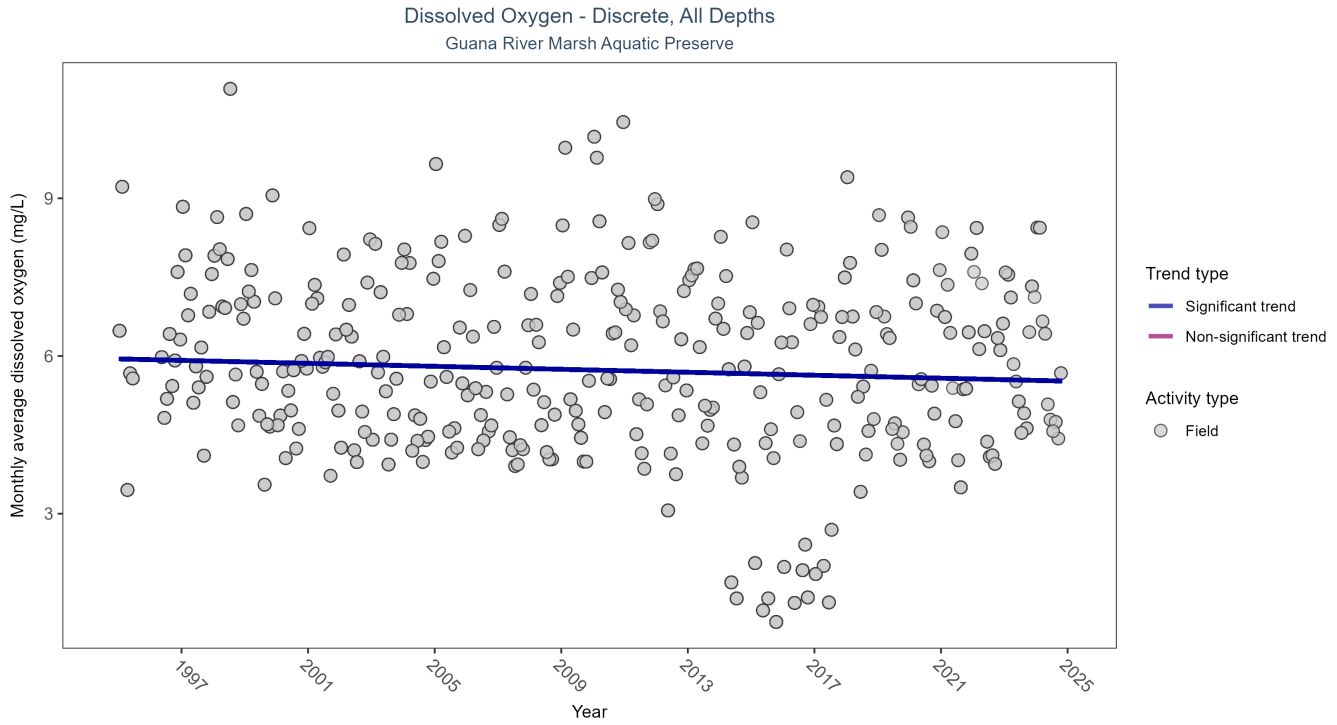

Figure 7: Scatter plot of monthly average dissolved oxygen over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only dissolved oxygen values measured in the field (circles) are included in the plot.

Table 12: Seasonal Kendall-Tau Trend Analysis for Dissolved Oxygen

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Field	Significantly decreasing trend	7614	30	1995 - 2024	5.7	-0.086	5.9443	-0.0141	0.0223

Monthly average dissolved oxygen decreased by 0.01 mg/L per year.

Figure 8: Map showing location of discrete water quality sampling locations within the boundaries of *Guana River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 13: Programs contributing data for Dissolved Oxygen

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	6616	1995	2024
4054	505	2002	2024
5014	239	2017	2022
69	150	2001	2010
95	130	2007	2018
103	57	2021	2021
118	1	2006	2006

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program[7]
95 - Harmful Algal Bloom Marine Observation Network[4]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[5]
118 - National Aquatic Resource Surveys, National Coastal Condition Assessment[6]
4054 - Guana Tolomato Matanzas National Estuarine Research Reserve System-Wide Monitoring Program[1]

5002 - Florida STORET / WIN[2]
5014 - Guana River and Guana Lake Water Quality Monitoring[3]

Dissolved Oxygen Saturation - Discrete

Seasonal Kendall-Tau Trend Analysis

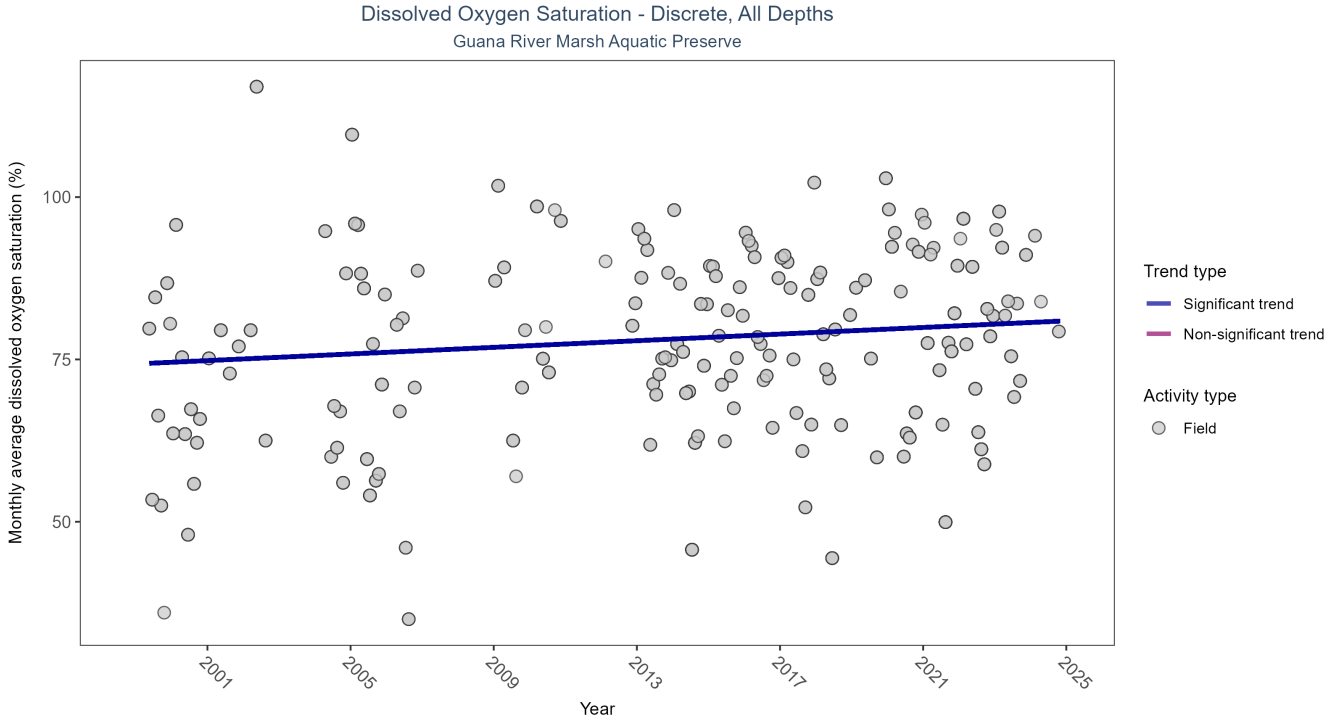

Figure 9: Scatter plot of monthly average dissolved oxygen saturation over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only dissolved oxygen saturation values measured in the field (circles)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

Table 14: Seasonal Kendall-Tau Trend Analysis for Dissolved Oxygen Saturation

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Field	Significantly increasing trend	1172	22	1999 - 2024	78.55	0.1203	74.3079	0.2552	0.0308

Monthly average dissolved oxygen saturation increased by 0.26% per year.

Figure 10: Map showing location of discrete water quality sampling locations within the boundaries of *Guana River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 15: Programs contributing data for Dissolved Oxygen Saturation

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	967	1999	2024
5014	220	2017	2022
95	3	2012	2013
4054	1	2022	2022

Program names:

95 - Harmful Algal Bloom Marine Observation Network[4]
4054 - Guana Tolomato Matanzas National Estuarine Research Reserve System-Wide Monitoring Program[1]
5002 - Florida STORET / WIN[2]
5014 - Guana River and Guana Lake Water Quality Monitoring[3]

pH - Discrete

Seasonal Kendall-Tau Trend Analysis

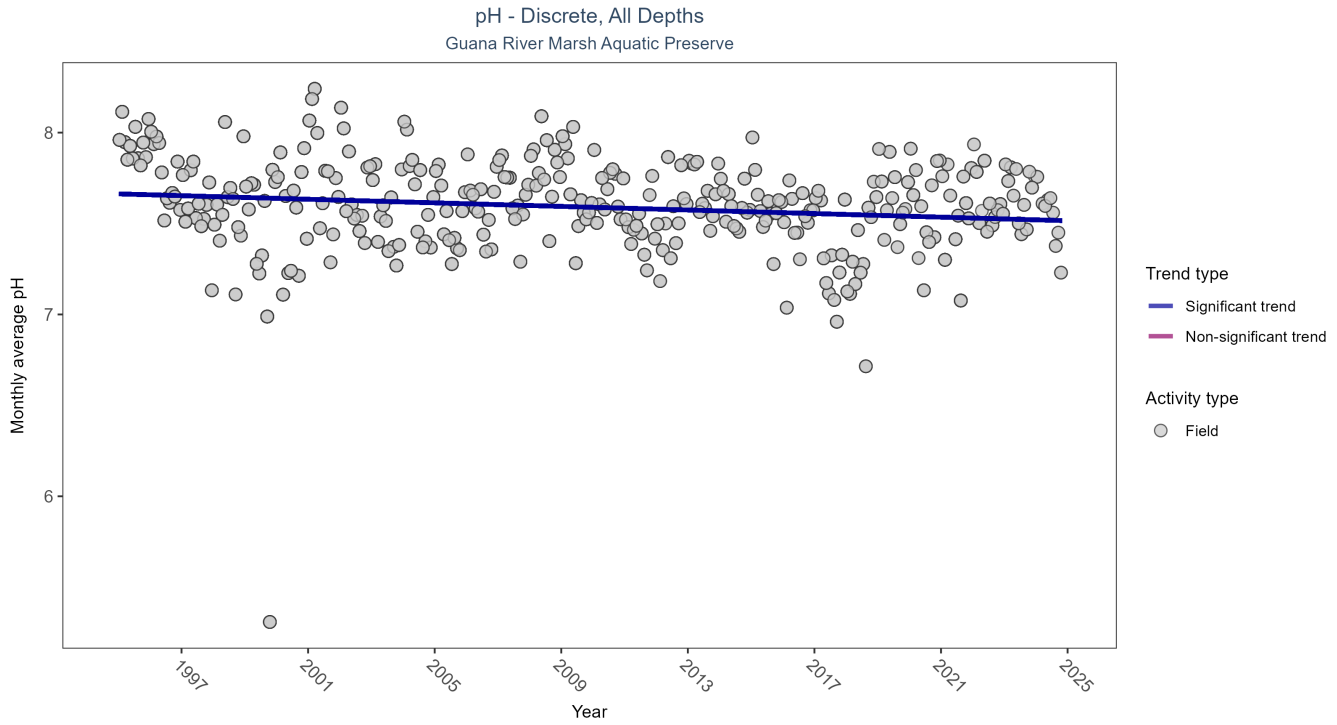

Figure 11: Scatter plot of monthly average pH over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only pH values measured in the field (circles) are included in the plot.

Table 16: Seasonal Kendall-Tau Trend Analysis for pH

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Field	Significantly decreasing trend	6191	30	1995 - 2024	7.7	-0.1467	7.663	-0.0049	0.0001

Monthly average pH decreased by less than 0.01 pH units per year.

Figure 12: Map showing location of discrete water quality sampling locations within the boundaries of *Guana River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 17: Programs contributing data for pH

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	5460	1995	2024
4054	507	2002	2024
5014	243	2017	2022
69	153	2001	2010
95	99	2007	2018
103	57	2021	2021

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program[7]
95 - Harmful Algal Bloom Marine Observation Network[4]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[5]
4054 - Guana Tolomato Matanzas National Estuarine Research Reserve System-Wide Monitoring Program[1]
5002 - Florida STORET / WIN[2]
5014 - Guana River and Guana Lake Water Quality Monitoring[3]

Salinity - Discrete

Seasonal Kendall-Tau Trend Analysis

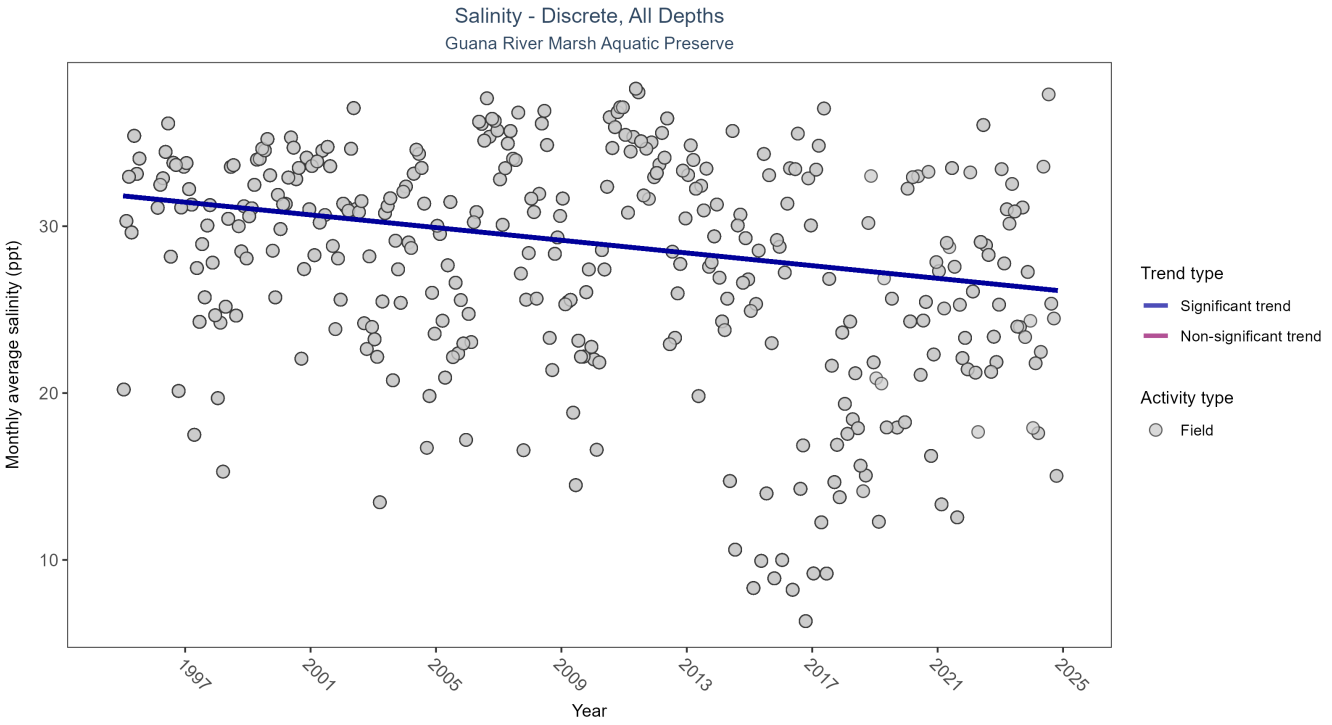

Figure 13: Scatter plot of monthly average salinity over time. If the time series included ten or more years of discrete observations, significant (blue) or non-significant (magenta) trend lines are also shown. Discrete salinity values derived from grab samples analyzed in the field (circles) or the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

Table 18: Seasonal Kendall-Tau Trend Analysis for Salinity

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
All	Significantly decreasing trend	8364	30	1995 - 2024	31	-0.1863	31.8209	-0.1902	0

Monthly average salinity decreased by 0.19 ppt per year.

Figure 14: Map showing location of discrete water quality sampling locations within the boundaries of *Guana River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 19: Programs contributing data for Salinity

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	7353	1995	2024
4054	403	2002	2024
5014	243	2017	2022
95	236	1999	2018
69	153	2001	2010

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program[7]
95 - Harmful Algal Bloom Marine Observation Network[4]
4054 - Guana Tolomato Matanzas National Estuarine Research Reserve System-Wide Monitoring Program[1]
5002 - Florida STORET / WIN[2]
5014 - Guana River and Guana Lake Water Quality Monitoring[3]

Secchi Depth - Discrete

Seasonal Kendall-Tau Trend Analysis

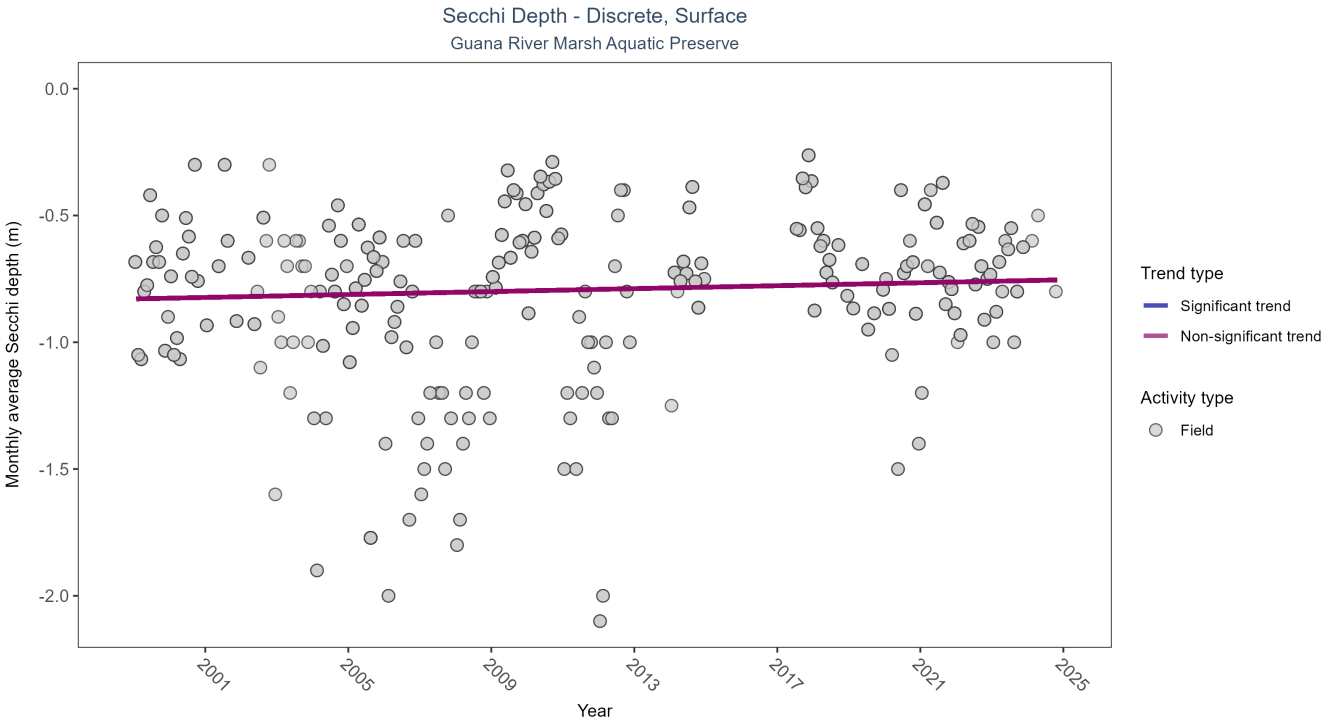

Figure 15: Scatter plot of monthly average Secchi depth over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Secchi depth is only measured in the field (circles).

Table 20: Seasonal Kendall-Tau Trend Analysis for Secchi Depth

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Field	No significant trend	1354	23	1999 - 2024	-0.7	0.069	-0.8291	0.0029	0.1854

Secchi depth showed no detectable trend between 1999 and 2024.

Figure 16: Map showing location of discrete water quality sampling locations within the boundaries of *Guana River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 21: Programs contributing data for Secchi Depth

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	716	1999	2024
4054	236	2002	2014
5014	215	2017	2022
69	153	2001	2010
103	35	2021	2021

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program[7]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[5]
4054 - Guana Tolomato Matanzas National Estuarine Research Reserve System-Wide Monitoring Program[1]
5002 - Florida STORET / WIN[2]
5014 - Guana River and Guana Lake Water Quality Monitoring[3]

Total Nitrogen - Discrete

Total Nitrogen Calculation:

The logic for calculated Total Nitrogen was provided by Kevin O'Donnell and colleagues at FDEP (with the help of Jay Silvanima, Watershed Monitoring Section). The following logic is used, in this order, based on the availability of specific nitrogen components.

1) TN = TKN + NO3O2;
2) TN = TKN + NO3 + NO2;
3) TN = ORGN + NH4 + NO3O2;
4) TN = ORGN + NH4 + NO2 + NO3;
5) TN = TKN + NO3;
6) TN = ORGN + NH4 + NO3;

Additional Information:

- Rules for use of sample fraction:
  - Florida Department of Environmental Protection (FDEP) report that if both "Total" and "Dissolved" components are reported, only "Total" is used. If the total is not reported, then the dissolved components are used as a best available replacement.
  - Total nitrogen calculations are done using nitrogen components with the same sample fraction, nitrogen components with mixed total/dissolved sample fractions are not used. In other words, total nitrogen can be calculated when TKN and NO3O2 are both total sample fractions, or when both are dissolved sample fractions. *Future calculations of total nitrogen values may be based on components with mixed sample fractions.*
- Values inserted into data:
  - ParameterName = "Total Nitrogen"
  - SEACAR_QAQCFlagCode = "1Q"
  - SEACAR_QAQC_Description = "SEACAR Calculated"

Seasonal Kendall-Tau Trend Analysis

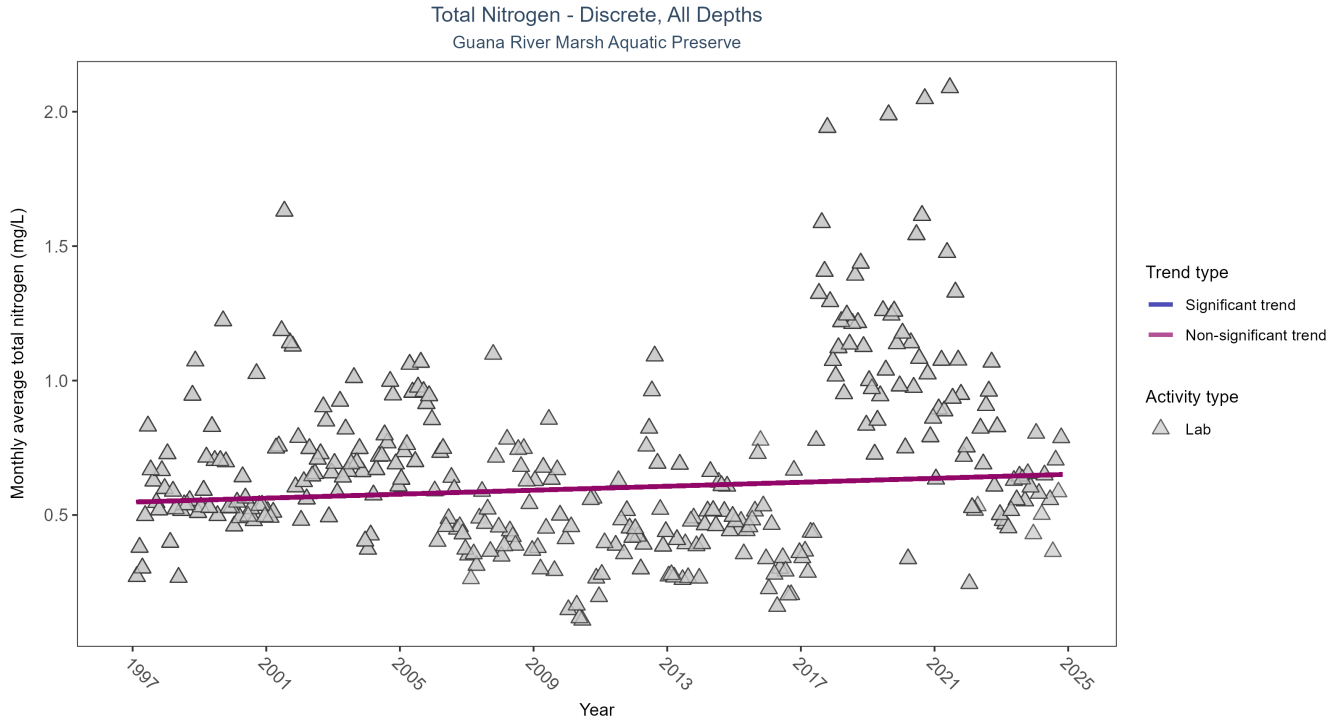

Figure 17: Scatter plot of monthly average total nitrogen over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only nitrogen values obtained from laboratory analyses (triangles) are included in the plot.

Table 22: Seasonal Kendall-Tau Trend Analysis for Total Nitrogen

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Lab	No significant trend	2020	28	1997 - 2024	0.613	0.0667	0.548	0.0037	0.0902

Total nitrogen showed no detectable trend between 1997 and 2024.

Figure 18: Map showing location of discrete water quality sampling locations within the boundaries of *Guana River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 23: Programs contributing data for Total Nitrogen

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	1154	1997	2024
5014	477	2017	2022
4054	414	2002	2024

Program names:

4054 - Guana Tolomato Matanzas National Estuarine Research Reserve System-Wide Monitoring Program[1]
5002 - Florida STORET / WIN[2]
5014 - Guana River and Guana Lake Water Quality Monitoring[3]

Total Phosphorus - Discrete

Seasonal Kendall-Tau Trend Analysis

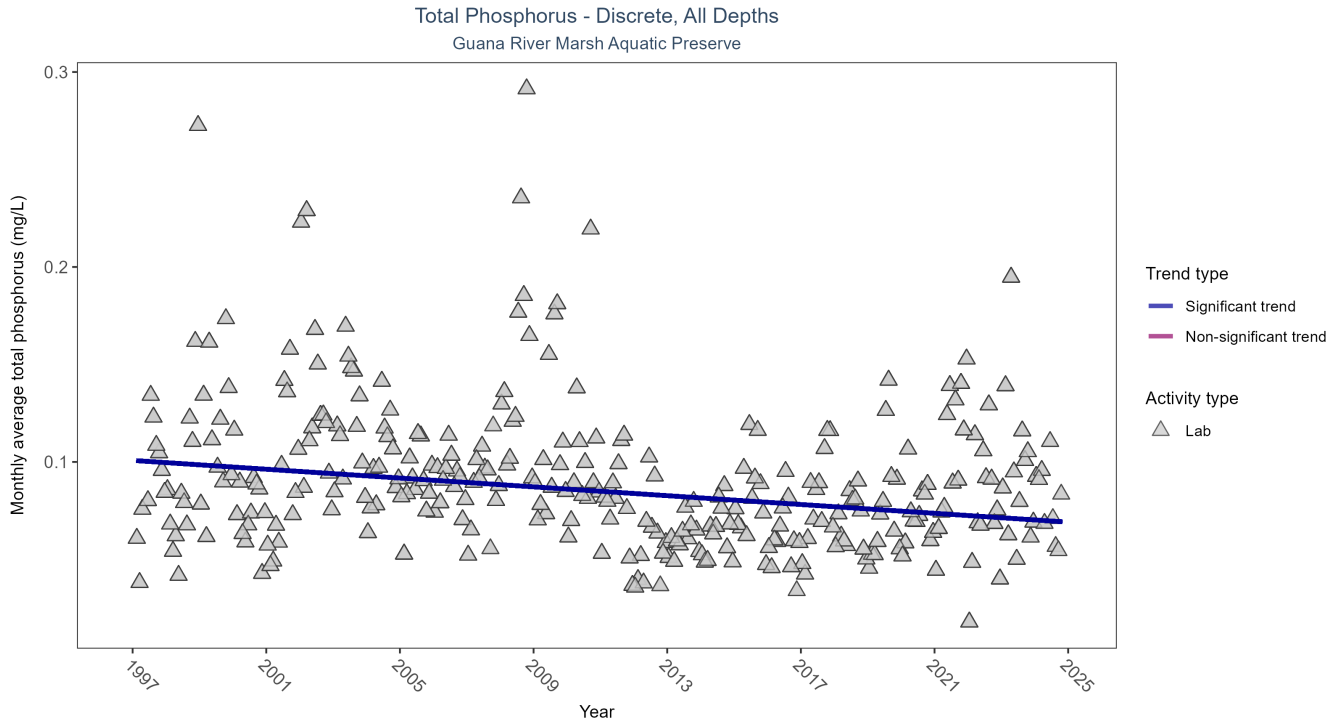

Figure 19: Scatter plot of monthly average total phosphorus over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only phosphorus values obtained from laboratory analyses (triangles) are included in the plot.

Table 24: Seasonal Kendall-Tau Trend Analysis for Total Phosphorus

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Lab	Significantly decreasing trend	2889	28	1997 - 2024	0.0755	-0.214	0.1008	-0.0011	0

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

Figure 20: Map showing location of discrete water quality sampling locations within the boundaries of *Guana River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 25: Programs contributing data for Total Phosphorus

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	1763	1997	2024
5014	589	2017	2024
4054	580	2002	2024
103	20	2021	2021

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[5]
4054 - Guana Tolomato Matanzas National Estuarine Research Reserve System-Wide Monitoring Program[1]
5002 - Florida STORET / WIN[2]
5014 - Guana River and Guana Lake Water Quality Monitoring[3]

Total Suspended Solids - Discrete

Seasonal Kendall-Tau Trend Analysis

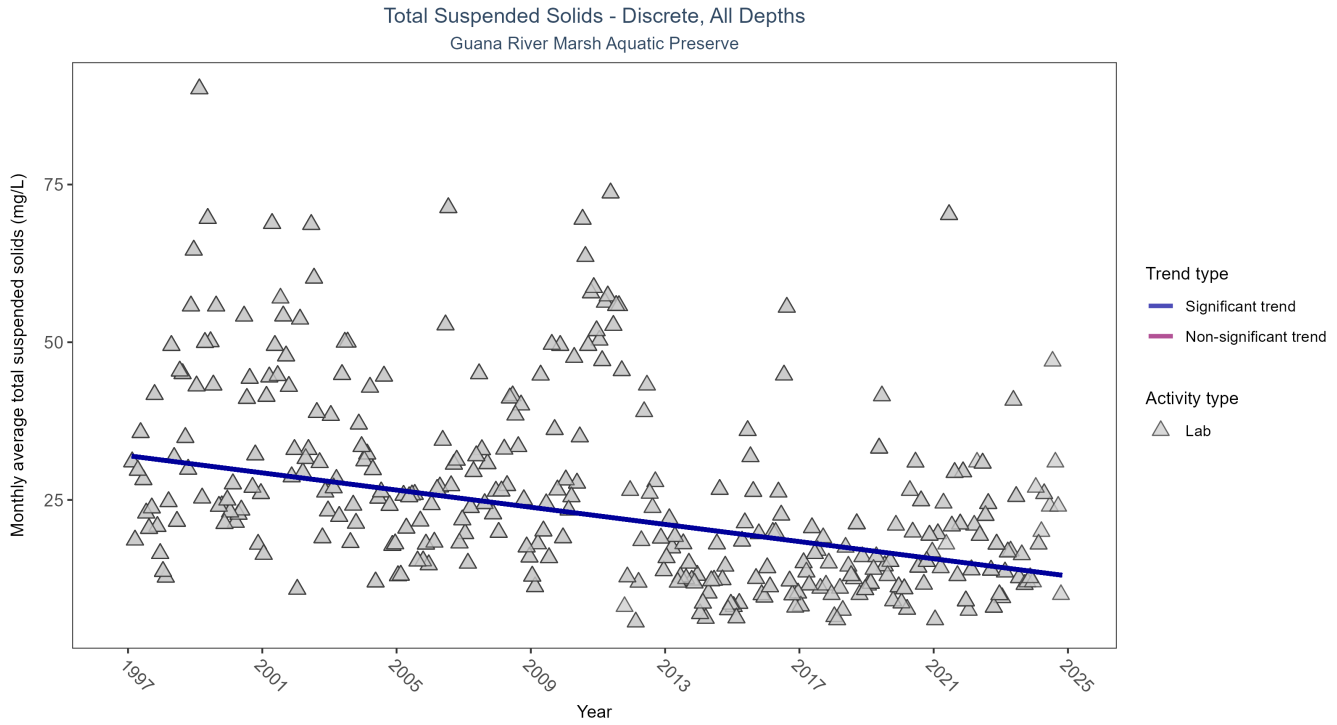

Figure 21: Scatter plot of monthly average total suspended solids (TSS) over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only TSS values obtained from laboratory analyses (triangles) are included in the plot.

Table 26: Seasonal Kendall-Tau Trend Analysis for Total Suspended Solids

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Lab	Significantly decreasing trend	1706	28	1997 - 2024	22.45	-0.3521	32.012	-0.6808	0

Monthly average total suspended solids decreased by 0.68 mg/L per year, indicating an increase in water clarity.

Figure 22: Map showing location of discrete water quality sampling locations within the boundaries of *Guana River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 27: Programs contributing data for Total Suspended Solids

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	1366	1997	2024
4054	568	2002	2024
5014	126	2018	2022
103	20	2021	2021

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[5]
4054 - Guana Tolomato Matanzas National Estuarine Research Reserve System-Wide Monitoring Program[1]
5002 - Florida STORET / WIN[2]
5014 - Guana River and Guana Lake Water Quality Monitoring[3]

Turbidity - Discrete

Seasonal Kendall-Tau Trend Analysis

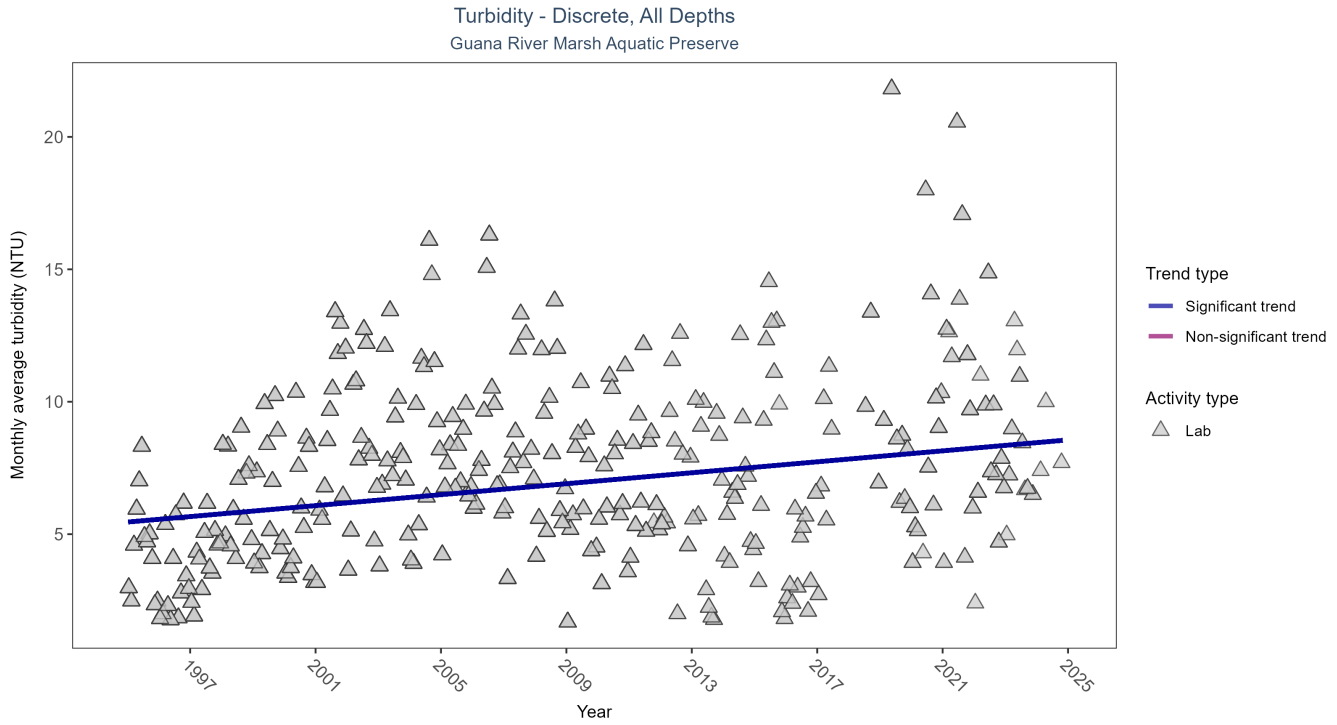

Figure 23: Scatter plot of monthly average turbidity over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only turbidity values measured in the laboratory (triangles) are included in the plot.

Table 28: Seasonal Kendall-Tau Trend Analysis for Turbidity

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Lab	Significantly increasing trend	5008	30	1995 - 2024	5.2	0.2159	5.4578	0.1034	0

Monthly average turbidity increased by 0.1 NTU per year, indicating a decrease in water clarity.

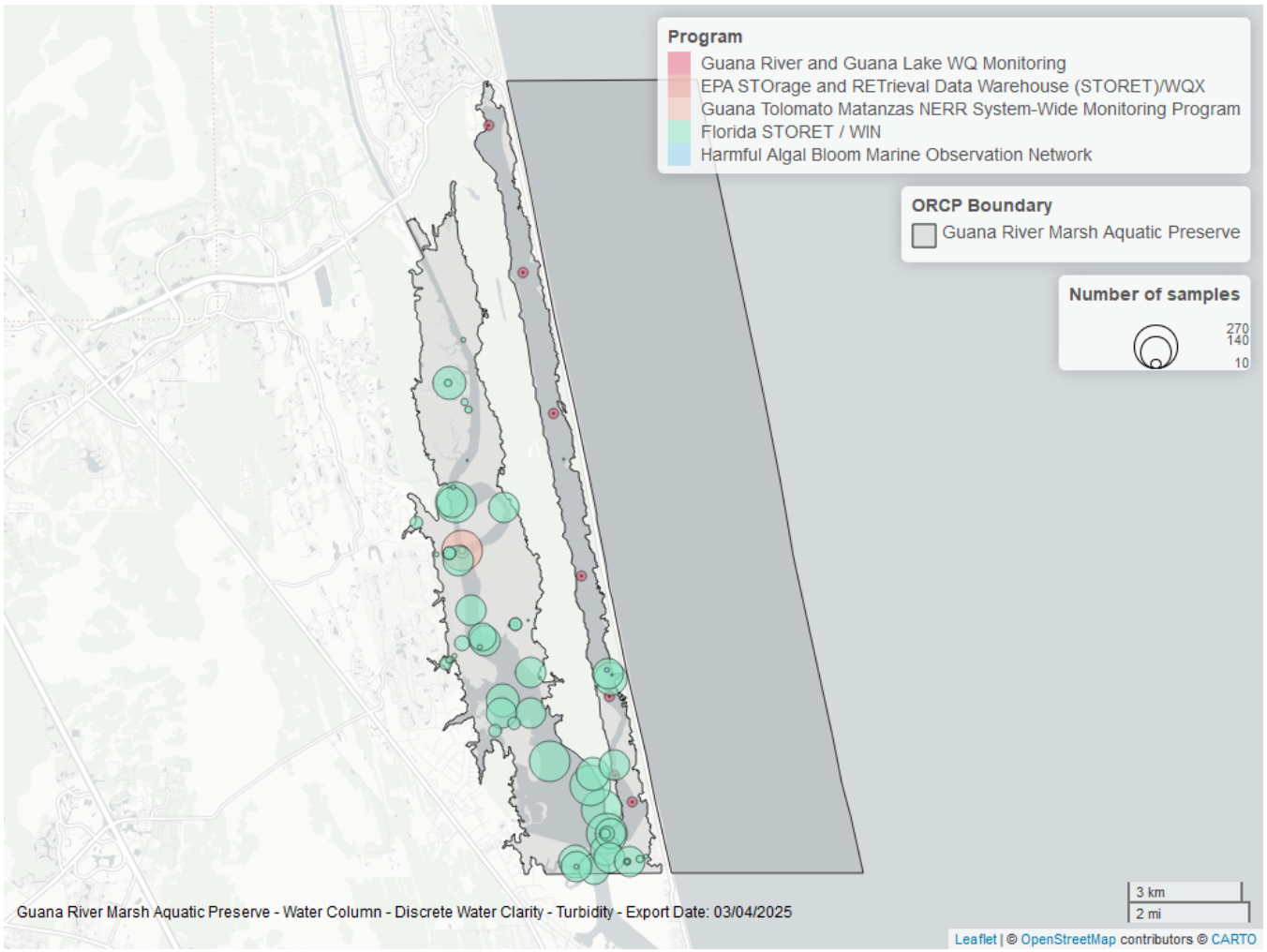

Figure 24: Map showing location of discrete water quality sampling locations within the boundaries of *Guana River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 29: Programs contributing data for Turbidity

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	4876	1995	2024
4054	288	2002	2021
5014	126	2018	2022
103	20	2021	2021
95	4	2012	2012

Program names:

95 - Harmful Algal Bloom Marine Observation Network[4]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[5]
4054 - Guana Tolomato Matanzas National Estuarine Research Reserve System-Wide Monitoring Program[1]
5002 - Florida STORET / WIN[2]
5014 - Guana River and Guana Lake Water Quality Monitoring[3]

Water Temperature - Discrete

Seasonal Kendall-Tau Trend Analysis

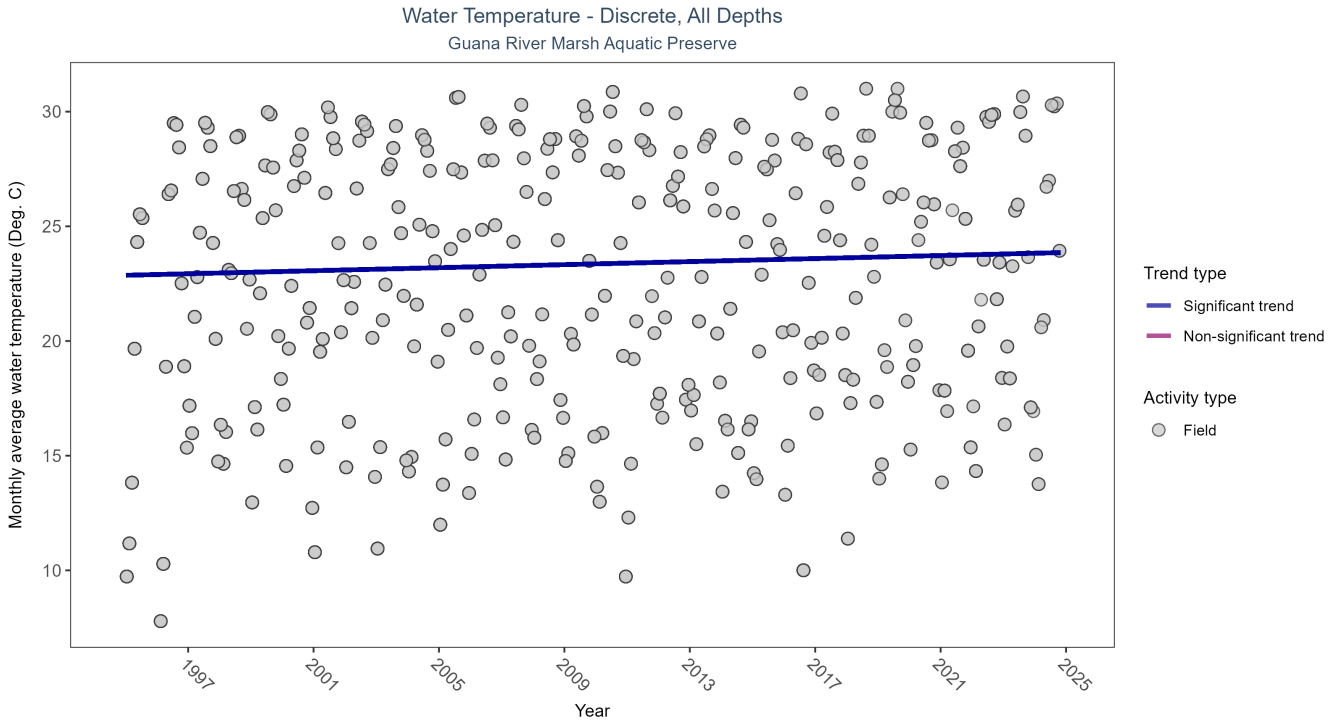

Figure 25: Scatter plot of monthly average water temperature over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only water temperature measurements taken in the field (circles) are included in the plot.

Table 30: Seasonal Kendall-Tau Trend Analysis for Water Temperature

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Field	Significantly increasing trend	8326	30	1995 - 2024	23.1	0.1195	22.8654	0.0331	0.0015

Monthly average water temperature increased by 0.03°C per year.

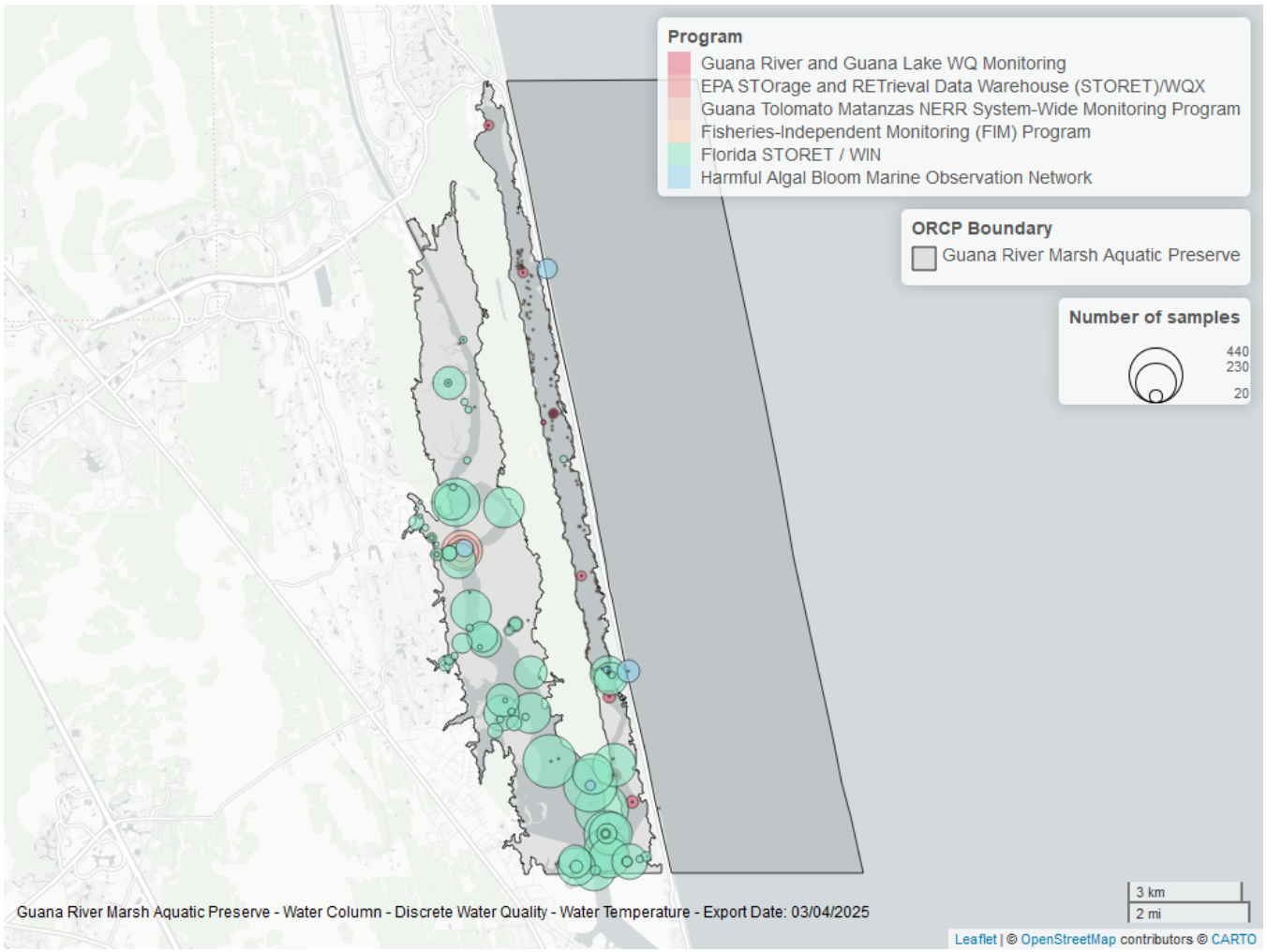

Figure 26: Map showing location of discrete water quality sampling locations within the boundaries of *Guana River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 31: Programs contributing data for Water Temperature

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	7563	1995	2024
4054	517	2002	2024
5014	243	2017	2022
95	228	2007	2018
69	153	2001	2010
103	57	2021	2021

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program[7]
95 - Harmful Algal Bloom Marine Observation Network[4]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[5]
4054 - Guana Tolomato Matanzas National Estuarine Research Reserve System-Wide Monitoring Program[1]
5002 - Florida STORET / WIN[2]
5014 - Guana River and Guana Lake Water Quality Monitoring[3]

Water Quality - Continuous

The following files were used in the continuous analysis:

- *Combined_WQ_WC_NUT_cont_Dissolved_Oxygen_NE-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_cont_Dissolved_Oxygen_Saturation_NE-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_cont_pH_NE-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_cont_Salinity_NE-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_cont_Turbidity_NE-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_cont_Water_Temperature_NE-2025-Mar-06.txt*

Continuous monitoring locations in Guana River Marsh Aquatic Preserve

Table 32: Station overview for Continuous parameters by Program

ProgramID	*ProgramLocationID*	*Years of Data*	*Use in Analysis*	*Parameters*
4054	gtmpiwq	24	TRUE	Sal , TempW
4054	gtmpiwq	25	TRUE	DO , DOS , pH , Turb
5062	872-0494	2	FALSE	Sal , TempW

Program names:

4054 - Guana Tolomato Matanzas National Estuarine Research Reserve System-Wide Monitoring Program[1]
5062 - FDEP Bureau of Survey and Mapping Continuous Water Quality Program[8]

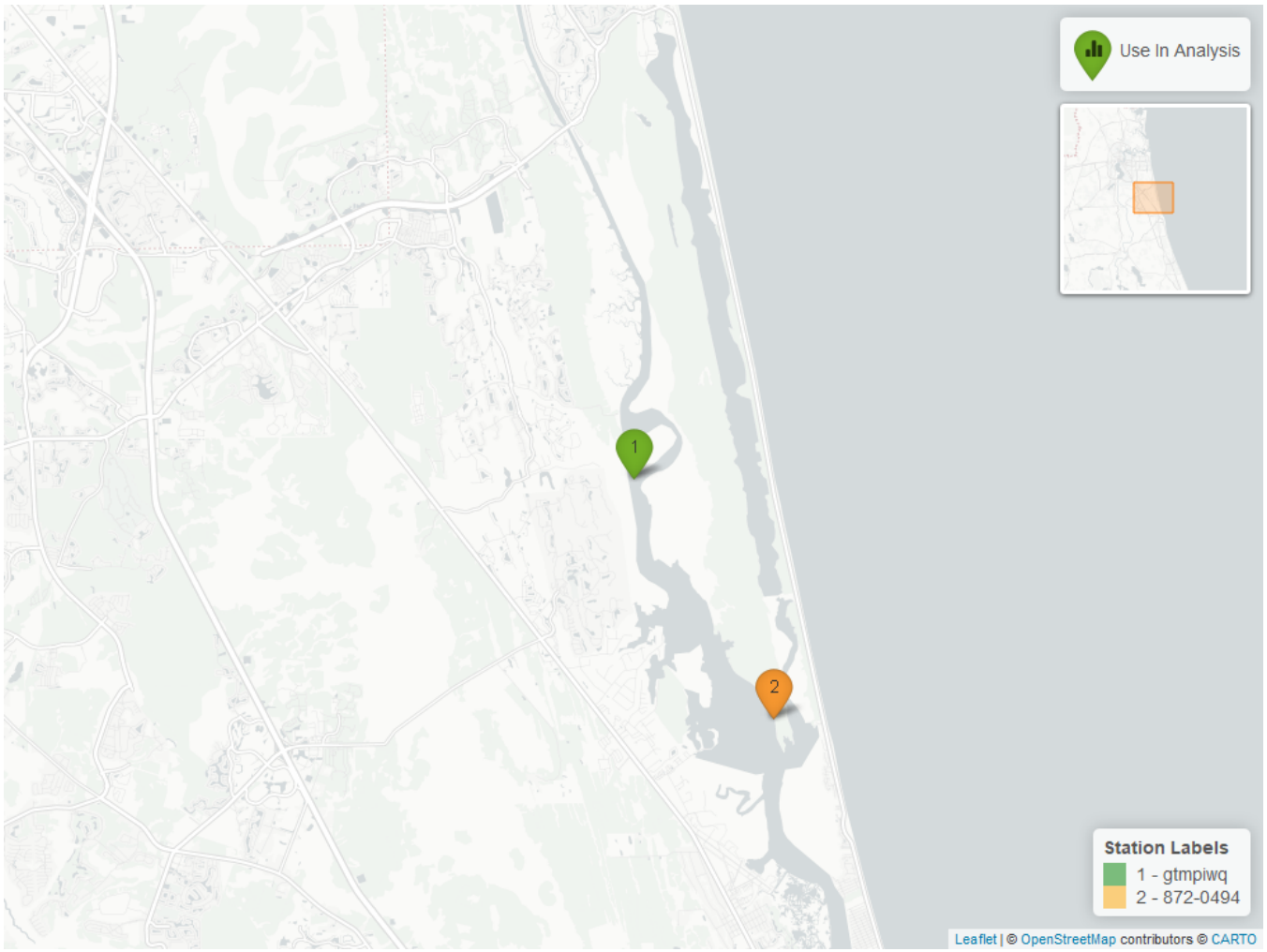

Figure 27: Map showing continuous water quality sampling locations within the boundaries of *Guana River Marsh Aquatic Preserve*. Sites marked as *Use In Analysis* (green) are featured in this report.

Dissolved Oxygen - Continuous

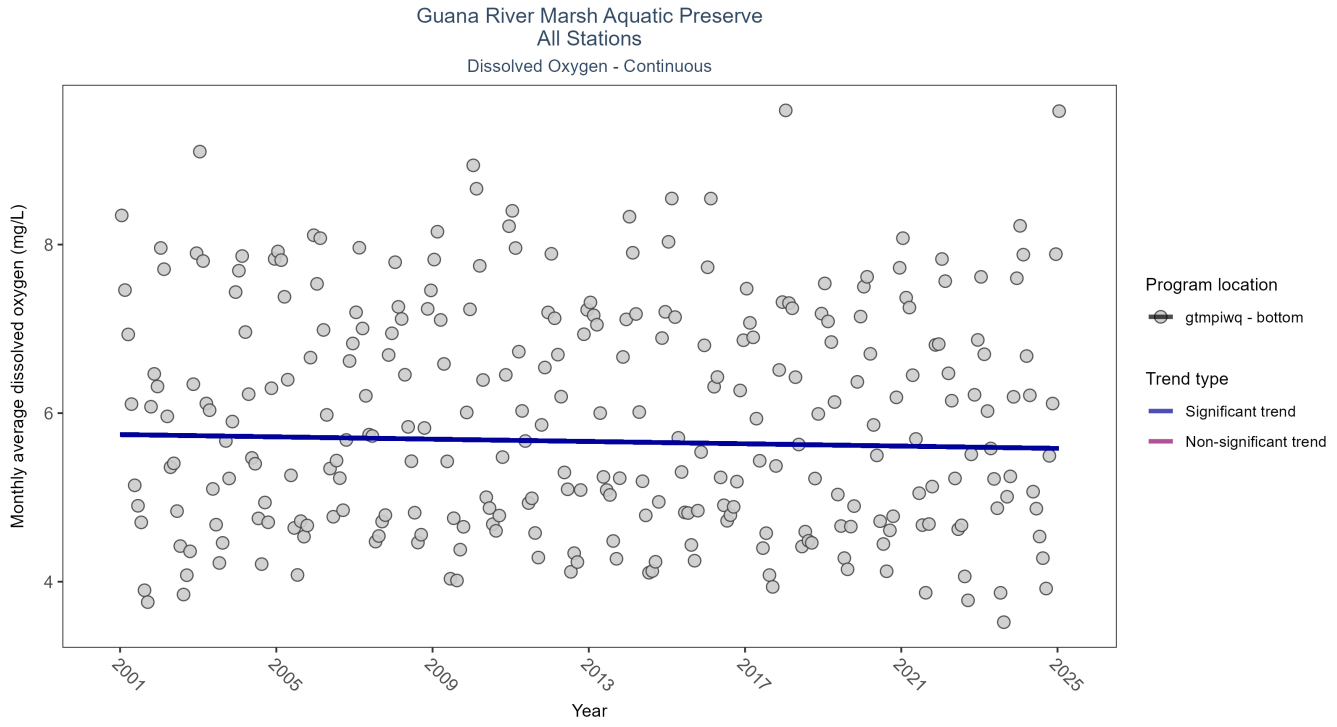

Figure 28: Scatter plot of monthly average dissolved oxygen over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 33: Seasonal Kendall-Tau Results for Dissolved Oxygen - All Stations

Station	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
gtmpiwq	Significantly decreasing trend	665008	25	2001 - 2025	5.9	-0.09	5.75	-0.01	0.04

At one program location, monthly average dissolved oxygen decreased by 0.01 mg/L per year.

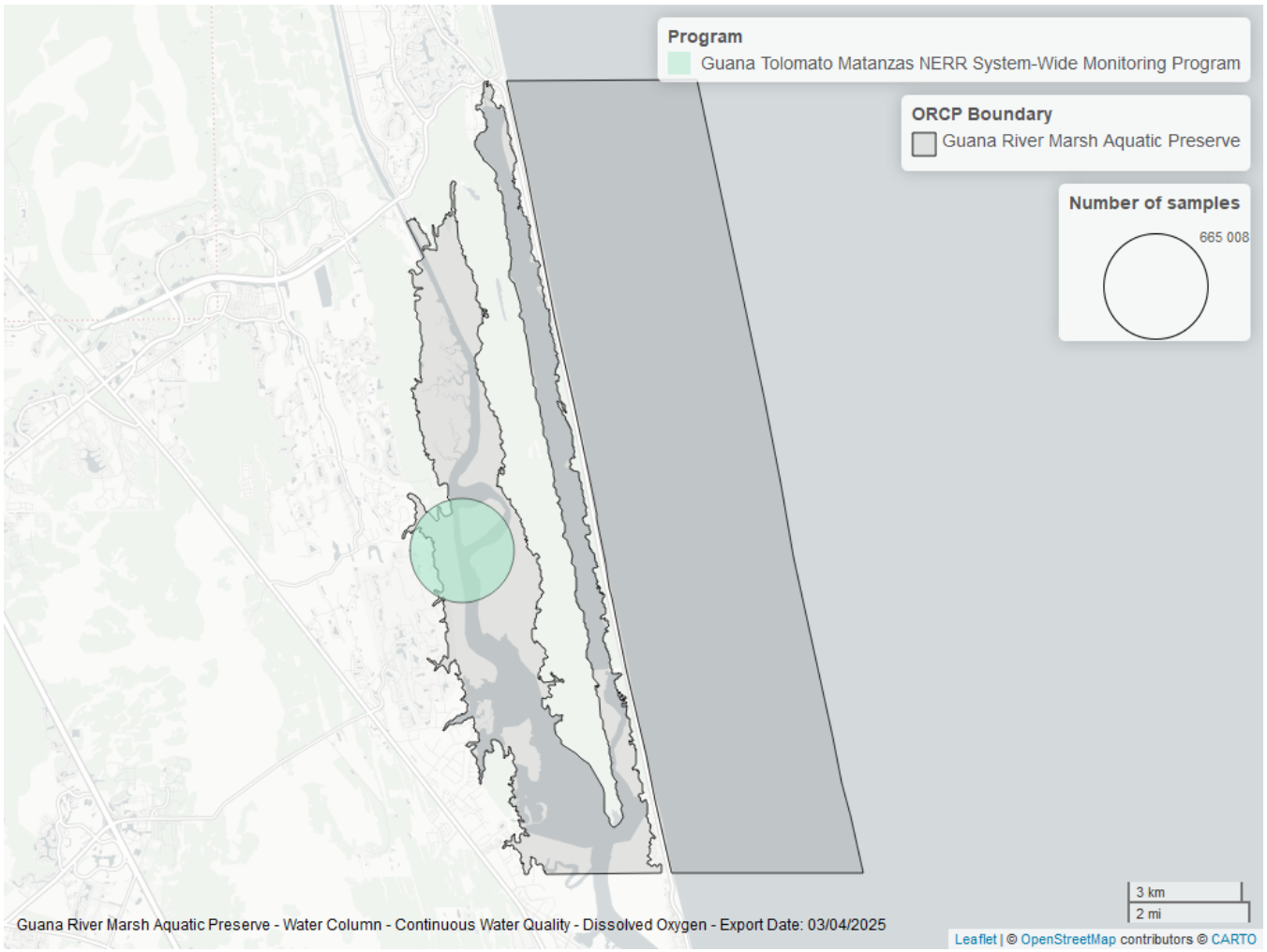

Figure 29: Map showing location of dissolved oxygen continuous water quality sampling locations within the boundaries of *Guana River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Dissolved Oxygen Saturation - Continuous

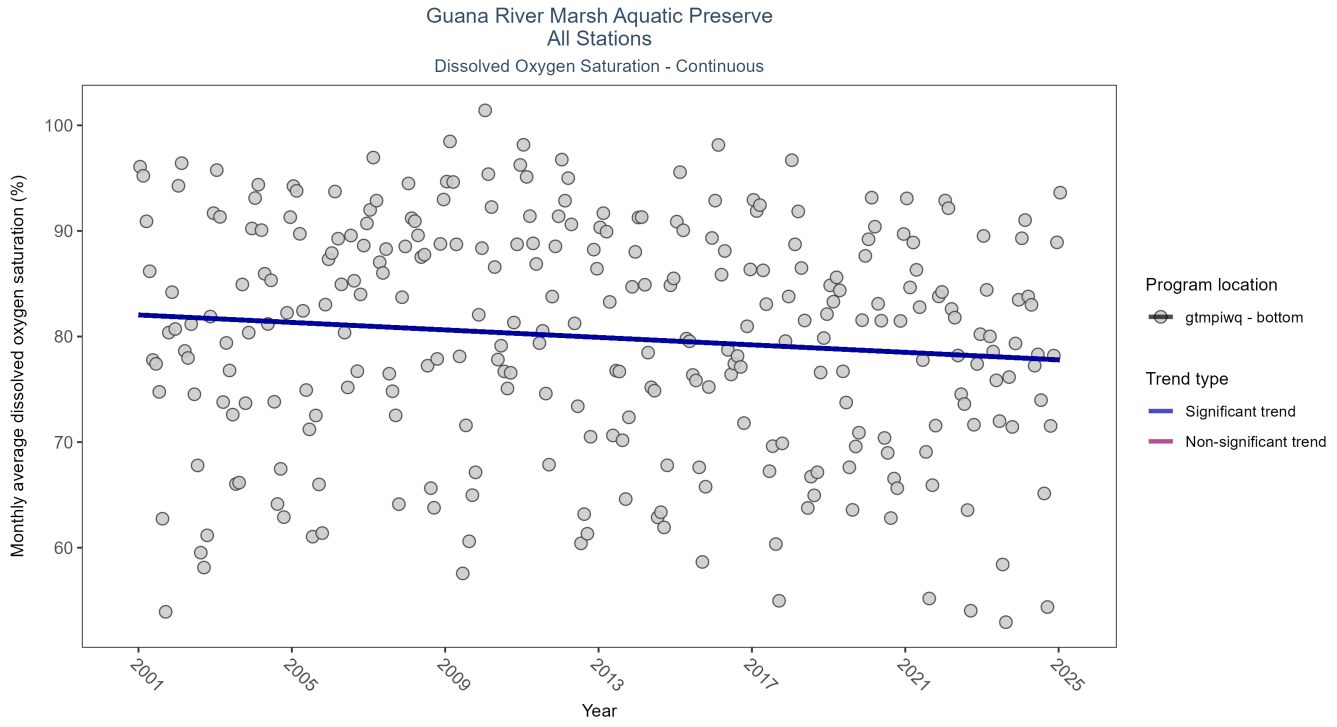

Figure 30: Scatter plot of monthly average dissolved oxygen saturation over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 34: Seasonal Kendall-Tau Results for Dissolved Oxygen Saturation - All Stations

Station	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
gtmpiwq	Significantly decreasing trend	670820	25	2001 - 2025	82.2	-0.18	82.04	-0.18	0

At one program location, monthly average dissolved oxygen saturation decreased by 0.18% per year.

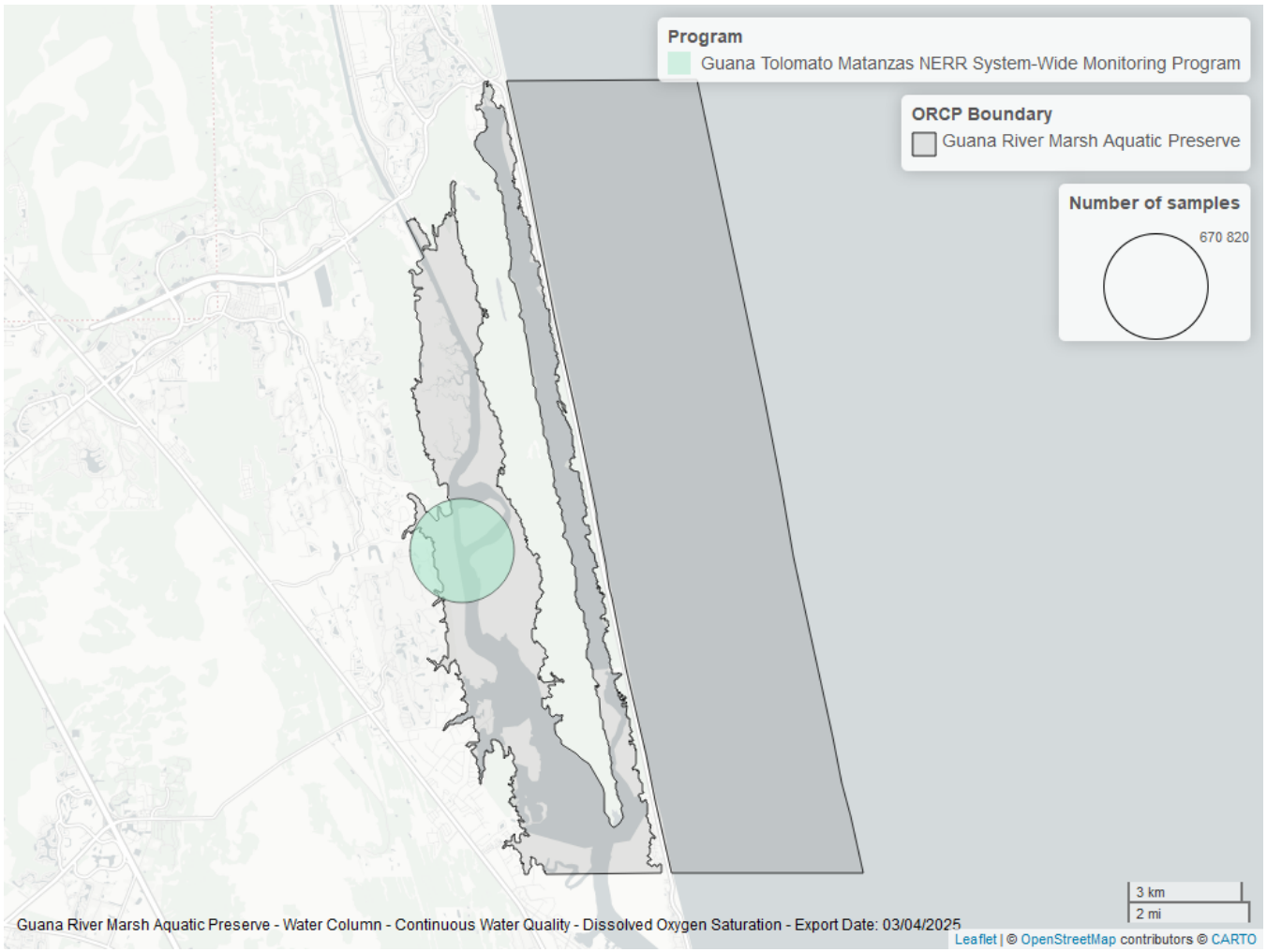

Figure 31: Map showing location of dissolved oxygen saturation continuous water quality sampling locations within the boundaries of *Guana River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

pH - Continuous

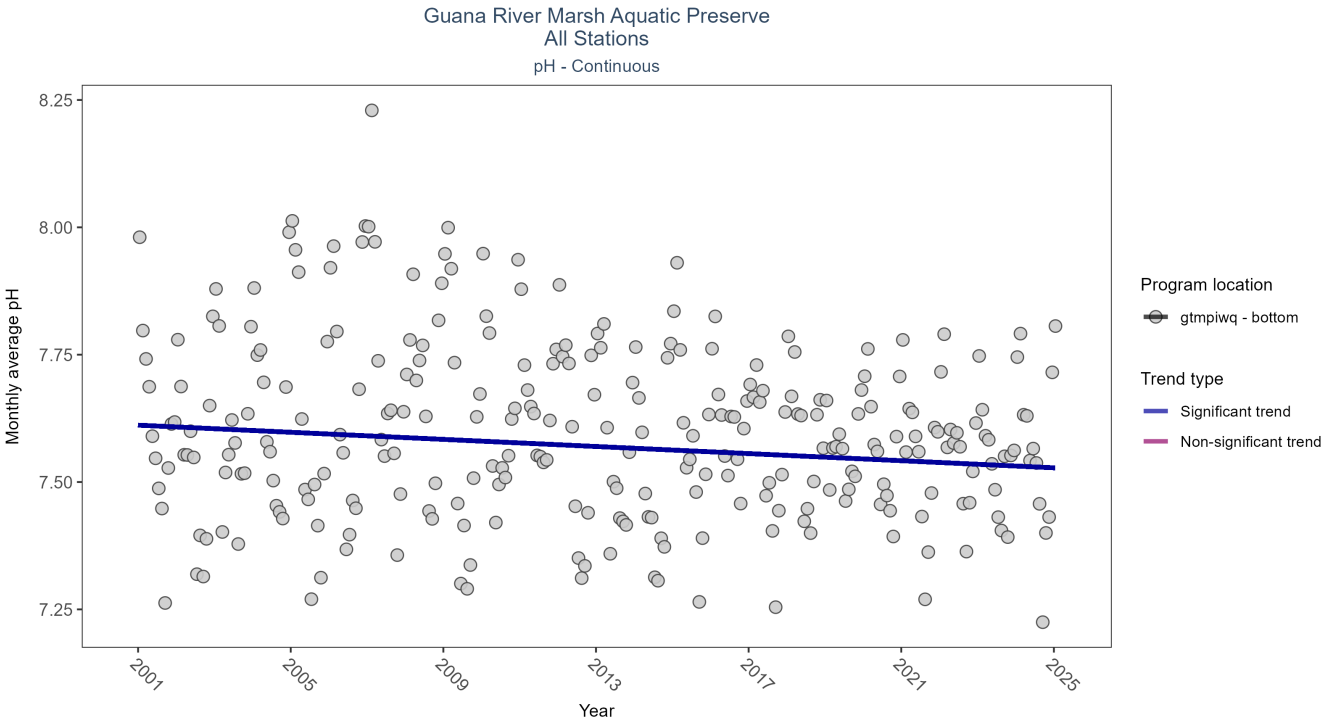

Figure 32: Scatter plot of monthly average pH over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 35: Seasonal Kendall-Tau Results for pH - All Stations

Station	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
gtmpiwq	Significantly decreasing trend	661500	25	2001 - 2025	7.6	-0.17	7.61	0	0

At one program location, monthly average pH decreased by less than 0.01 pH units per year.

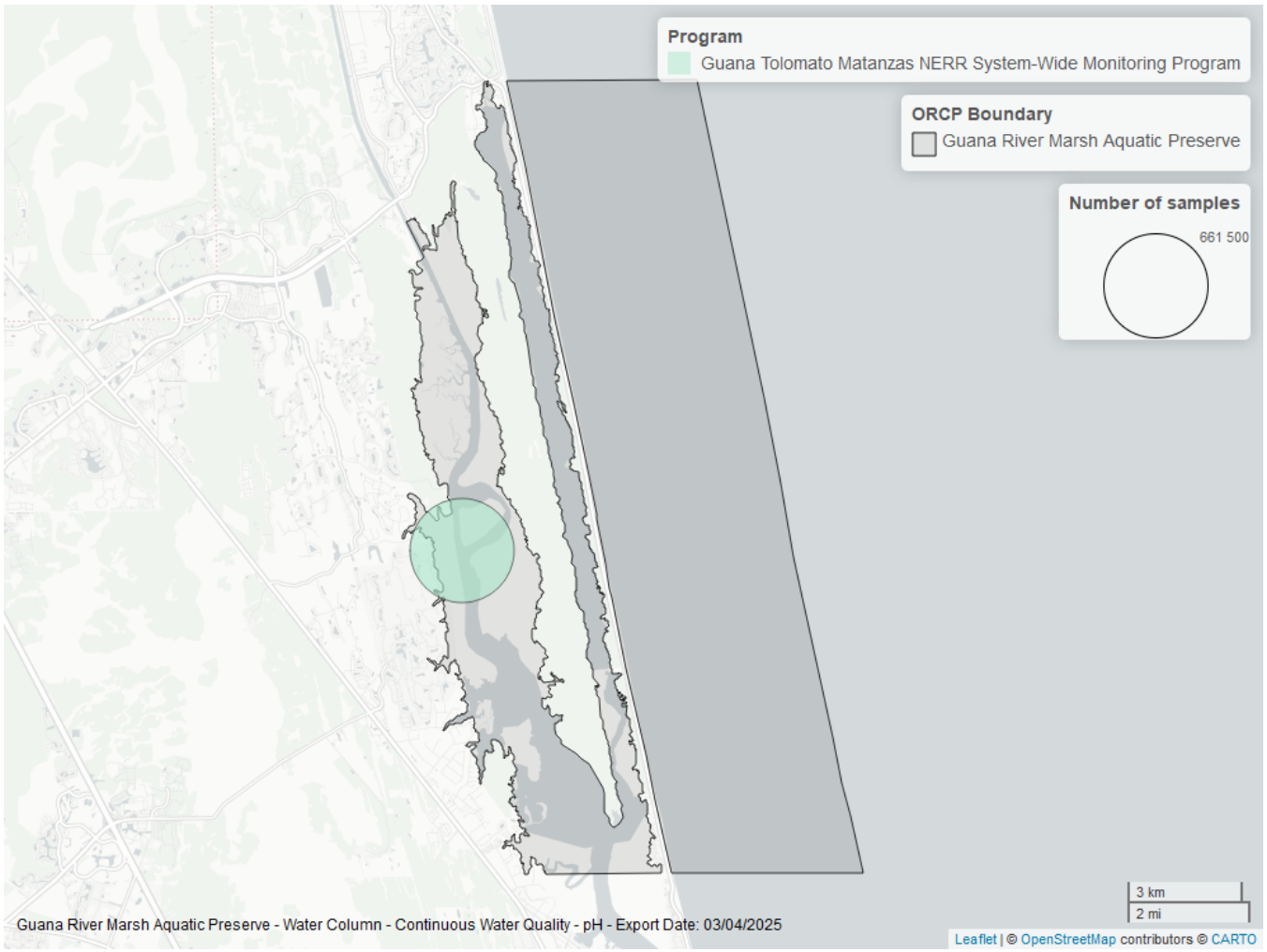

Figure 33: Map showing location of ph continuous water quality sampling locations within the boundaries of *Guana River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Salinity - Continuous

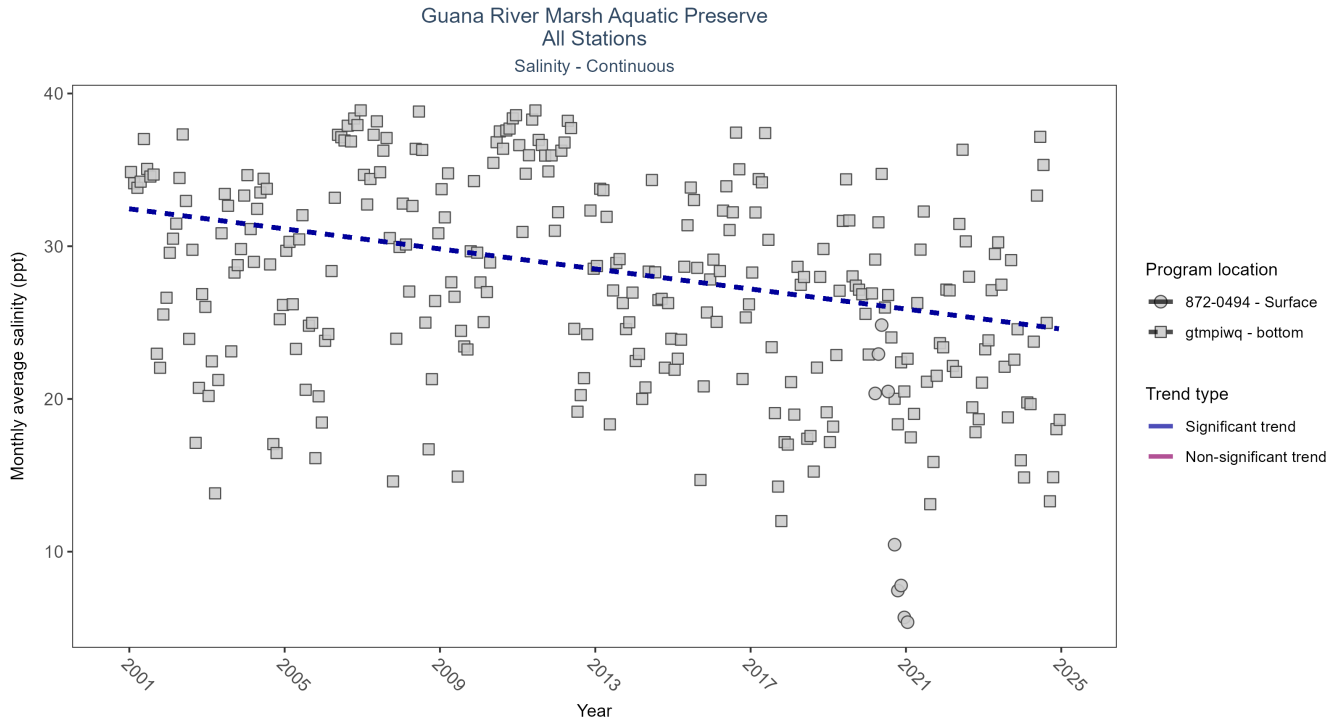

Figure 34: Scatter plot of monthly average salinity over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 36: Seasonal Kendall-Tau Results for Salinity - All Stations

Station	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
gtmpiwq	Significantly decreasing trend	666468	24	2001 - 2024	27.90	-0.26	32.45	-0.33	0
872-0494	Insufficient data to calculate trend	34918	2	2020 - 2021	8.99	-	-	-	-

At one program location, monthly average salinity decreased by 0.33 ppt per year. There was insufficient data to fit a model for one location.

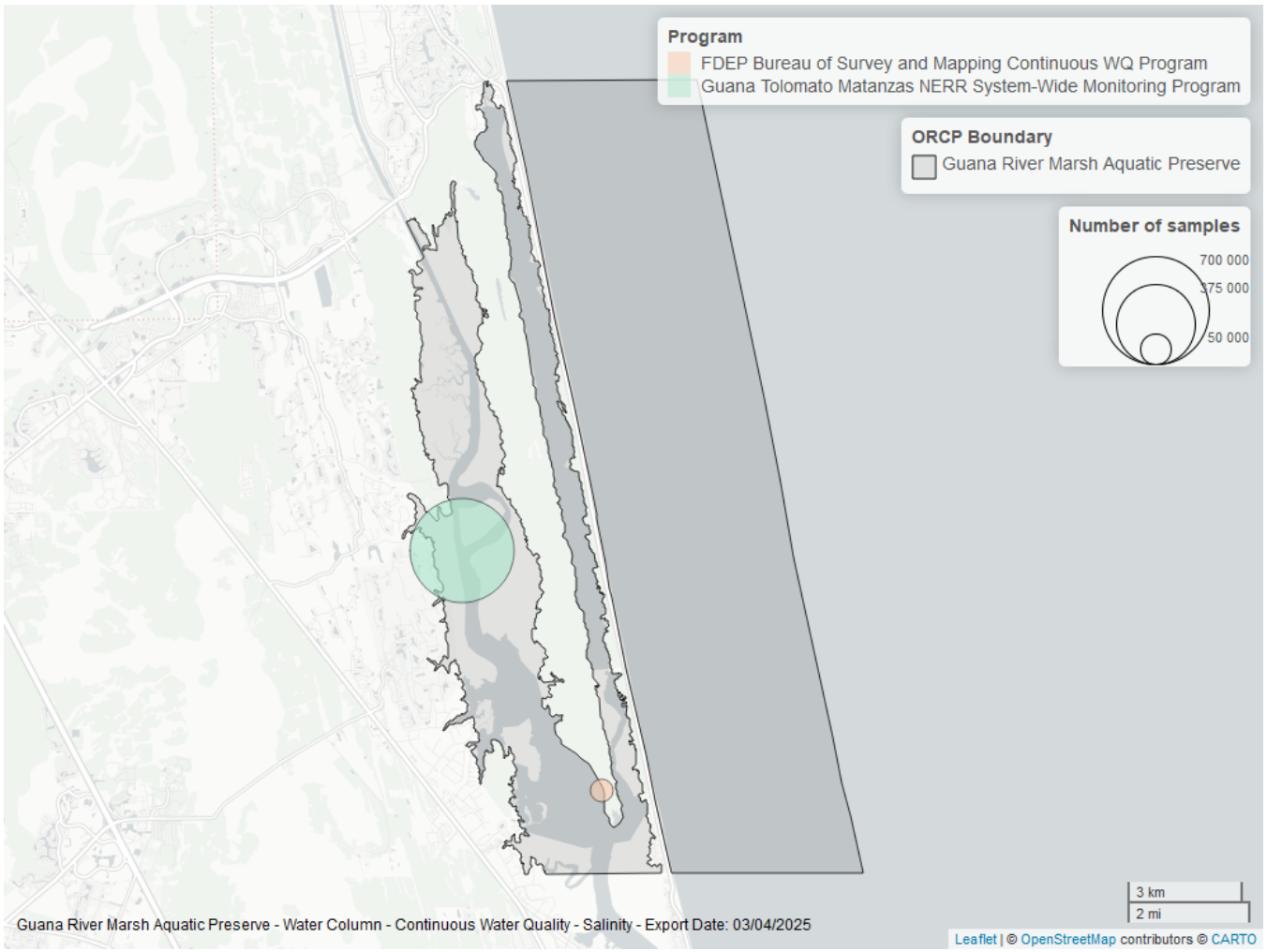

Figure 35: Map showing location of salinity continuous water quality sampling locations within the boundaries of *Guana River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Turbidity - Continuous

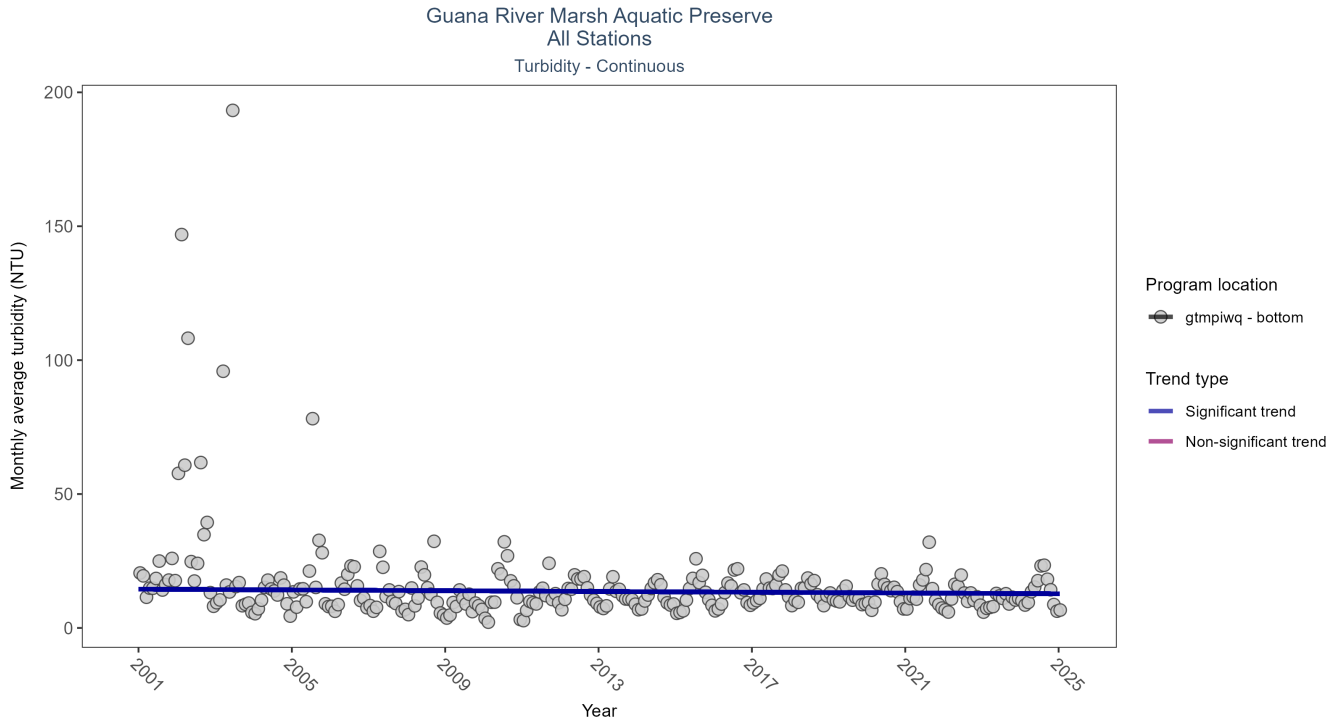

Figure 36: Scatter plot of monthly average turbidity over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 37: Seasonal Kendall-Tau Results for Turbidity - All Stations

Station	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
gtmpiwq	Significantly decreasing trend	643280	25	2001 - 2025	10	-0.1	14.48	-0.07	0.02

At one program location, monthly average turbidity decreased by 0.07 NTU per year.

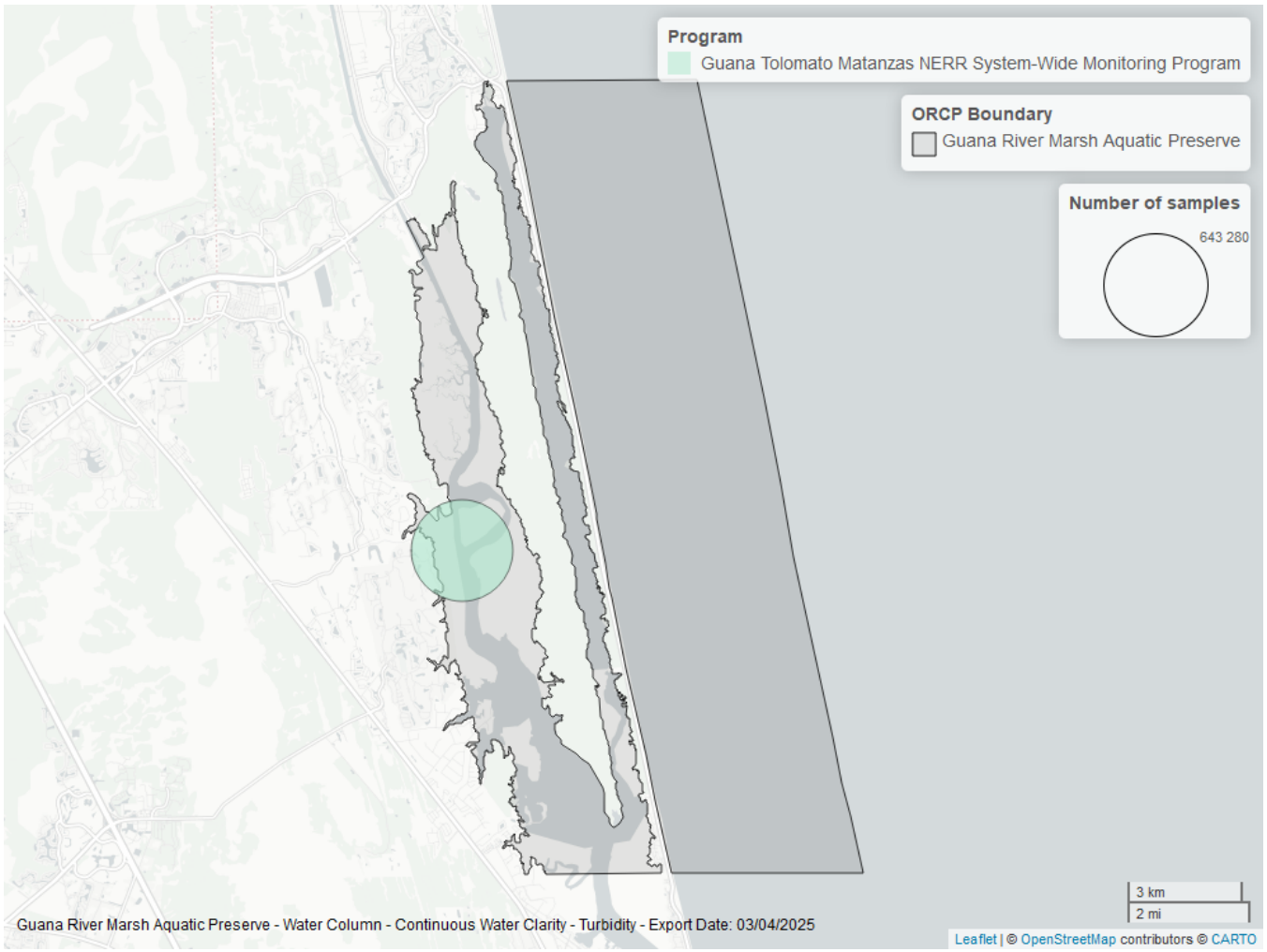

Figure 37: Map showing location of turbidity continuous water quality sampling locations within the boundaries of *Guana River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Water Temperature - Continuous

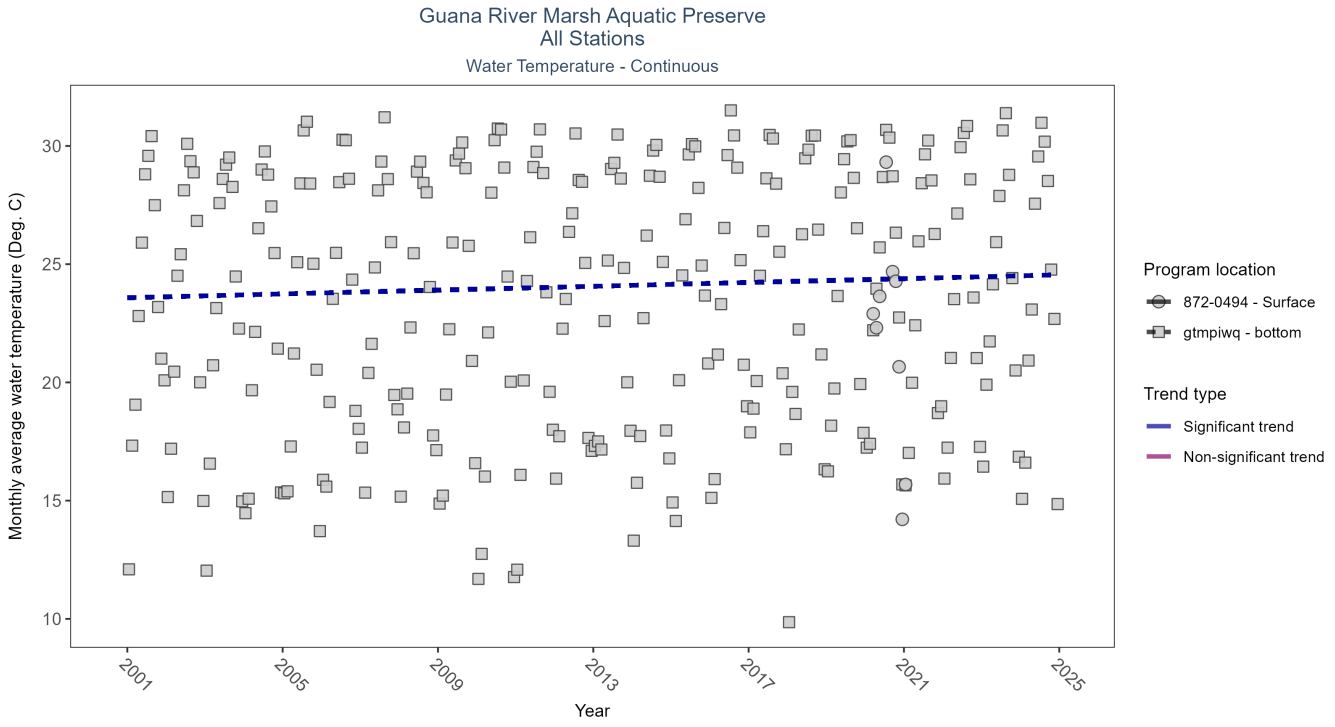

Figure 38: Scatter plot of monthly average water temperature over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 38: Seasonal Kendall-Tau Results for Water Temperature - All Stations

Station	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
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 one program location, monthly average water temperature increased by 0.04°C per year. There was insufficient data to fit a model for one location.

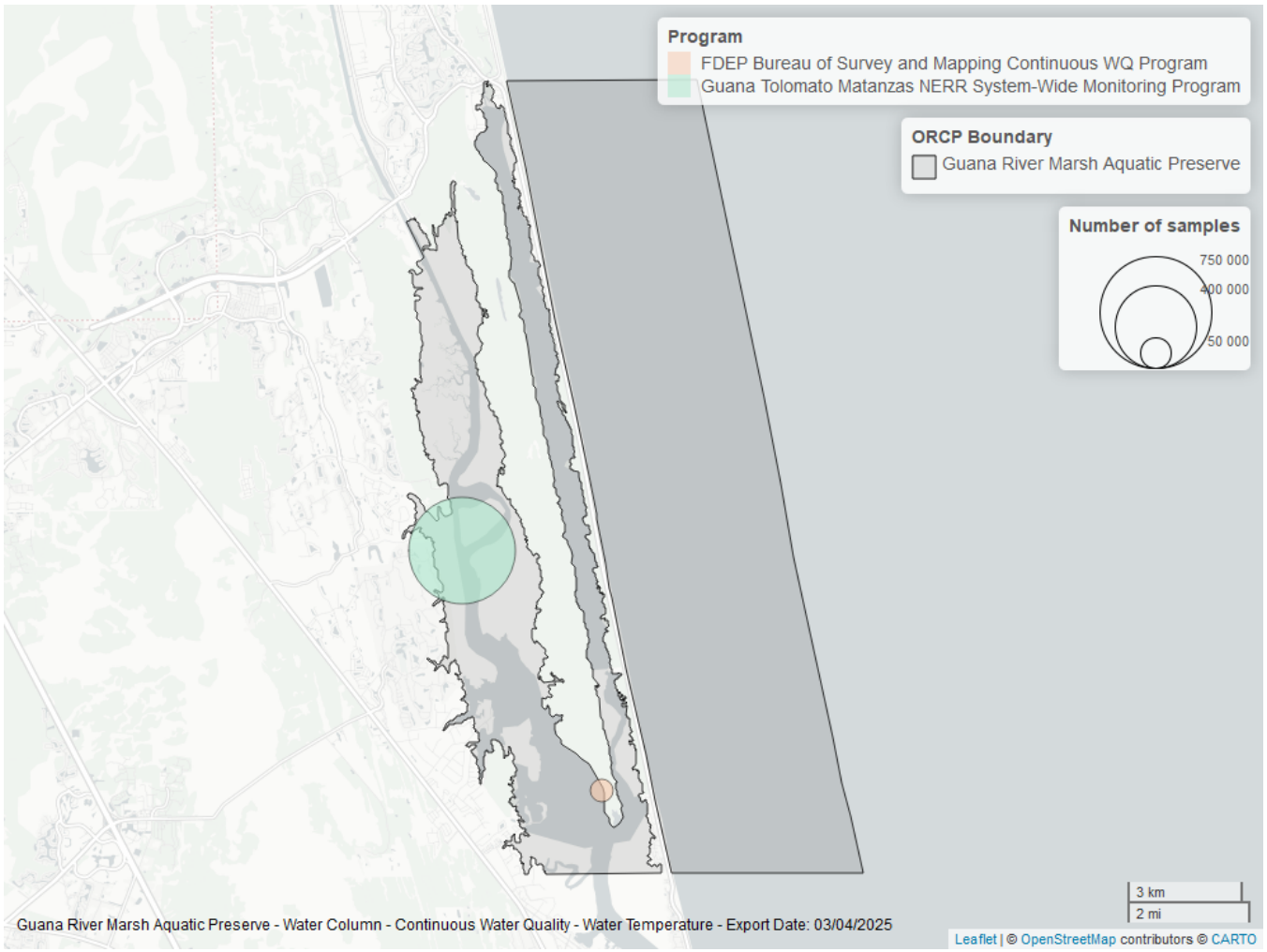

Figure 39: Map showing location of water temperature continuous water quality sampling locations within the boundaries of *Guana River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Coastal Wetlands

The data file used is: **All_CW_Parameters-2025-Mar-06.txt**

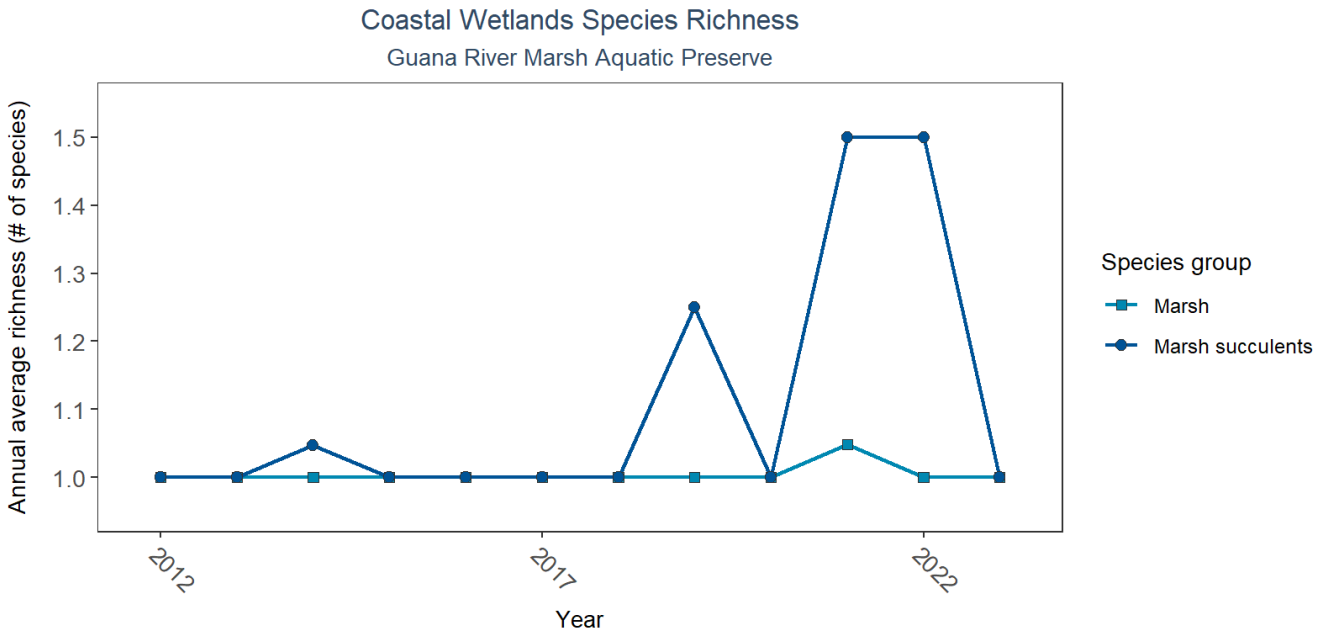

Figure 40: Line graph of annual average coastal wetlands species richness over time for mangroves and associates (triangles), marsh (squares), and marsh succulents (circles). If the time series by species group included more than one year of observations, a line connects data points for visualization.

Table 39: Coastal Wetlands Species Richness

Species Group	*Sample Count*	*Number of Years*	*Period of Record*	*Median N of Taxa*	*Mean N of Taxa*
Marsh	795	12	2012 - 2023	1	1.0
Marsh succulents	58	12	2012 - 2023	1	1.1

Between 2012 and 2023, the median annual number of species for *marsh* was 1 based on 795 observations. Between 2012 and 2023, the median annual number of species for *marsh succulents* was 1 based on 58 observations.

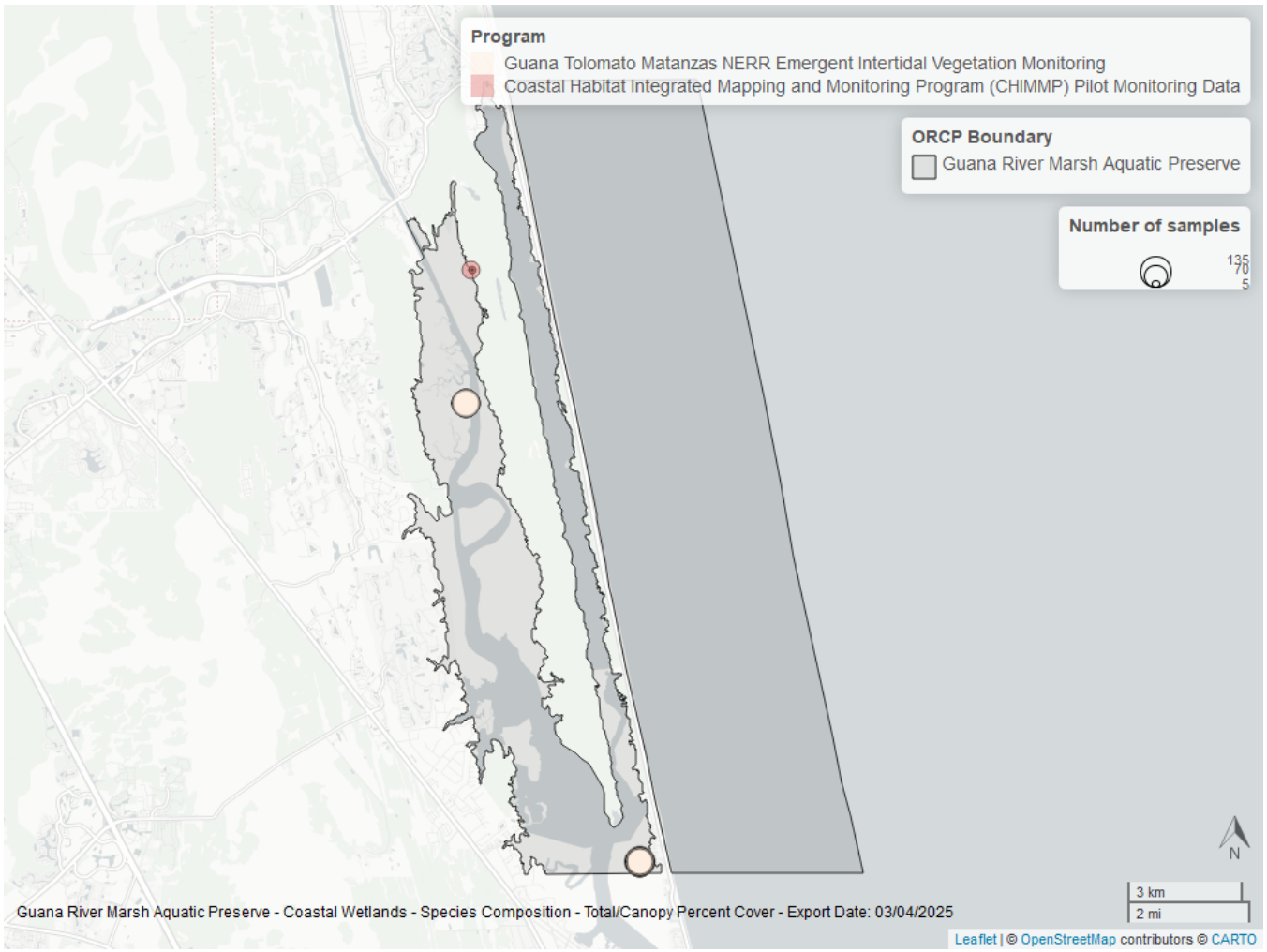

Figure 41: Map showing location of coastal wetlands sampling locations within the boundaries of *Guana River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Oyster

The data file used is: **All_OYSTER_Parameters-2025-Mar-26.txt**

Density

Natural

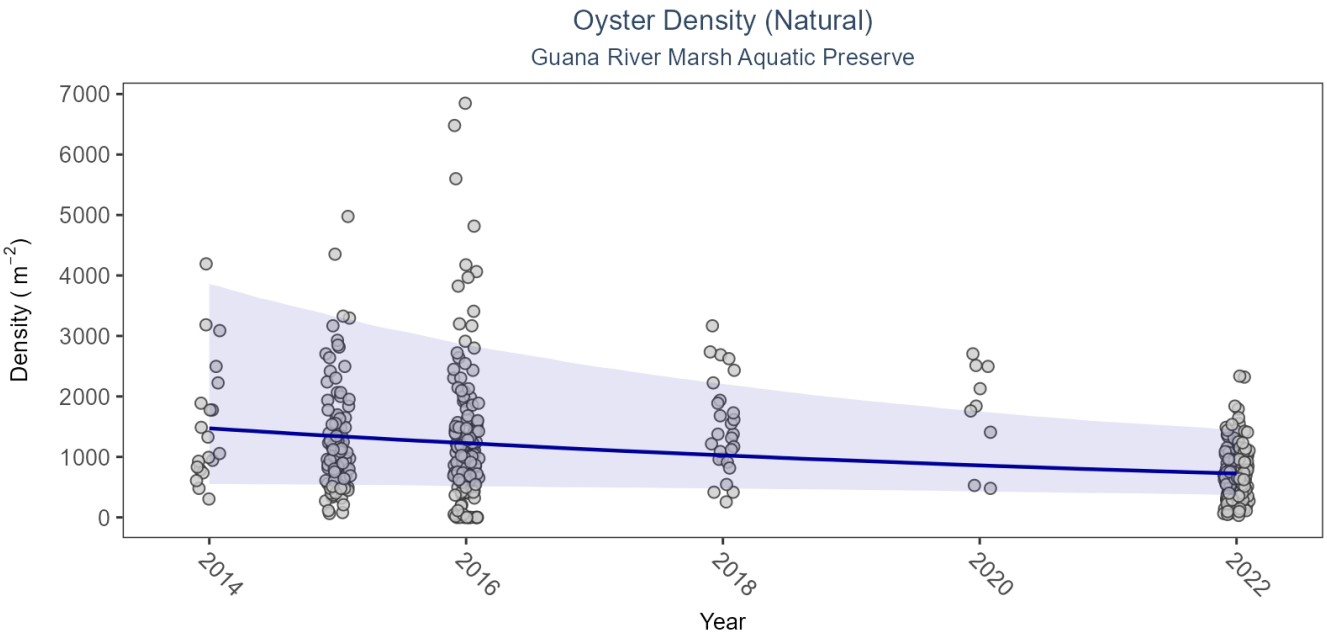

Figure 42: Scatter plot of oyster density over time. If the time series included five or more years with observations, an estimated trend (blue line) and a 95% credible interval (purple band) may also be plotted. Data points are jittered horizontally to reduce overlap.

Table 40: Model results for Oyster Density - Natural

Shell Type	*Habitat Type*	*Trend Status*	*Estimate*	*Standard Error*	*Credible Interval*
Live Oysters	Natural	Significantly decreasing trend	-93.52	381.66	-24.53 to -336.43

For natural reefs, density decreased by an average of 93.52 oysters per square meter per year.

Figure 43: Map showing location of oyster density sampling locations within the boundaries of *Guana River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Percent Live

Natural

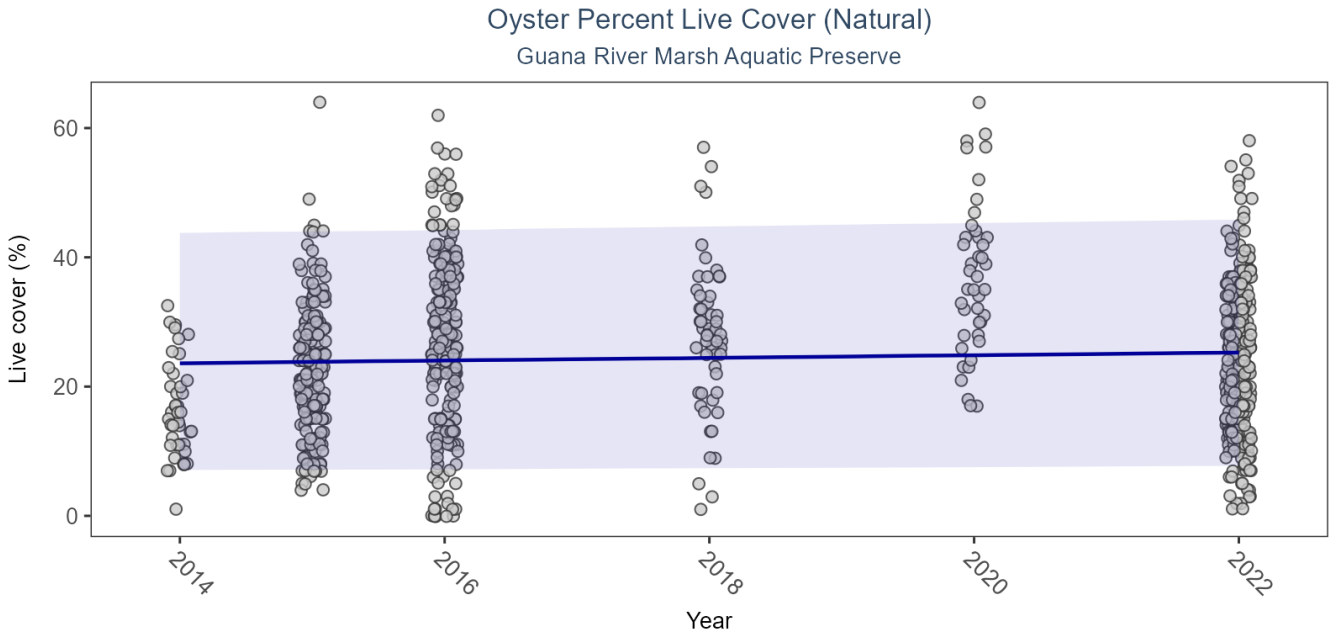

Figure 44: Scatter plot of percent live oysters over time. If the time series included five or more years with observations, an estimated trend (blue line) and a 95% credible interval (purple band) may also be plotted. Data points are jittered horizontally to reduce overlap.

Table 41: Model results for Oyster Percent Live - Natural

Shell Type	*Habitat Type*	*Trend Status*	*Estimate*	*Standard Error*	*Credible Interval*
Live Oysters	Natural	Significantly increasing trend	0.21	9.82	0.07 to 0.31

For natural reefs, percent live cover increased by an average of 0.21% per year.

Figure 45: Map showing location of oyster percent live sampling locations within the boundaries of *Guana River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Shell Height

Natural

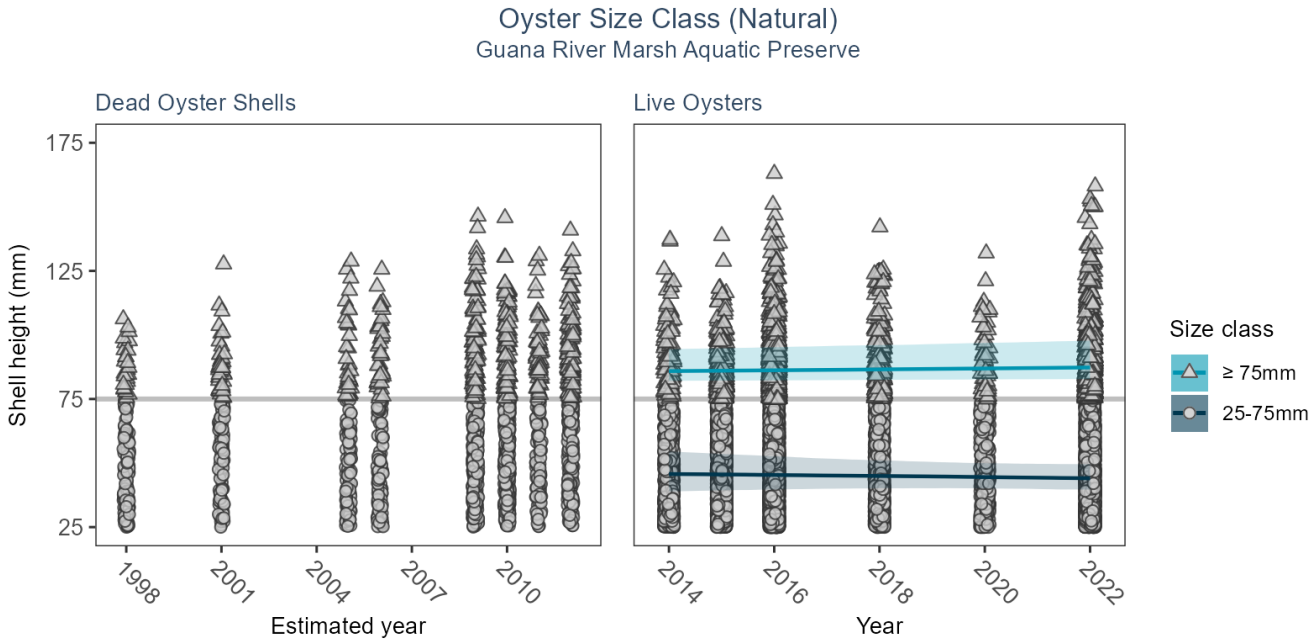

Table 42: Model results for Oyster Shell Height - Natural

Shell Type	*SizeClass*	*Habitat Type*	*Trend Status*	*Estimate*	*Standard Error*	*Credible Interval*
Dead Oyster Shells	>75mm	Natural	-	-	-	-
Dead Oyster Shells	25-75mm	Natural	-	-	-	-
Dead Oyster Shells		Natural	-	-	-	-
Live Oysters	>75mm	Natural	Significantly increasing trend	1.15	0.55	0.1 to 2.28
Live Oysters	25-75mm	Natural	Significantly decreasing trend	-1.85	0.90	-3.77 to -0.19
Live Oysters		Natural	-	-	-	-

For natural reefs, annual average live oyster shell height in the >=75mm size class increased by 1.15mm per year, and it decreased by 1.85mm per year in the 25-75mm size class. Models are not run on dead oyster shell measurements.

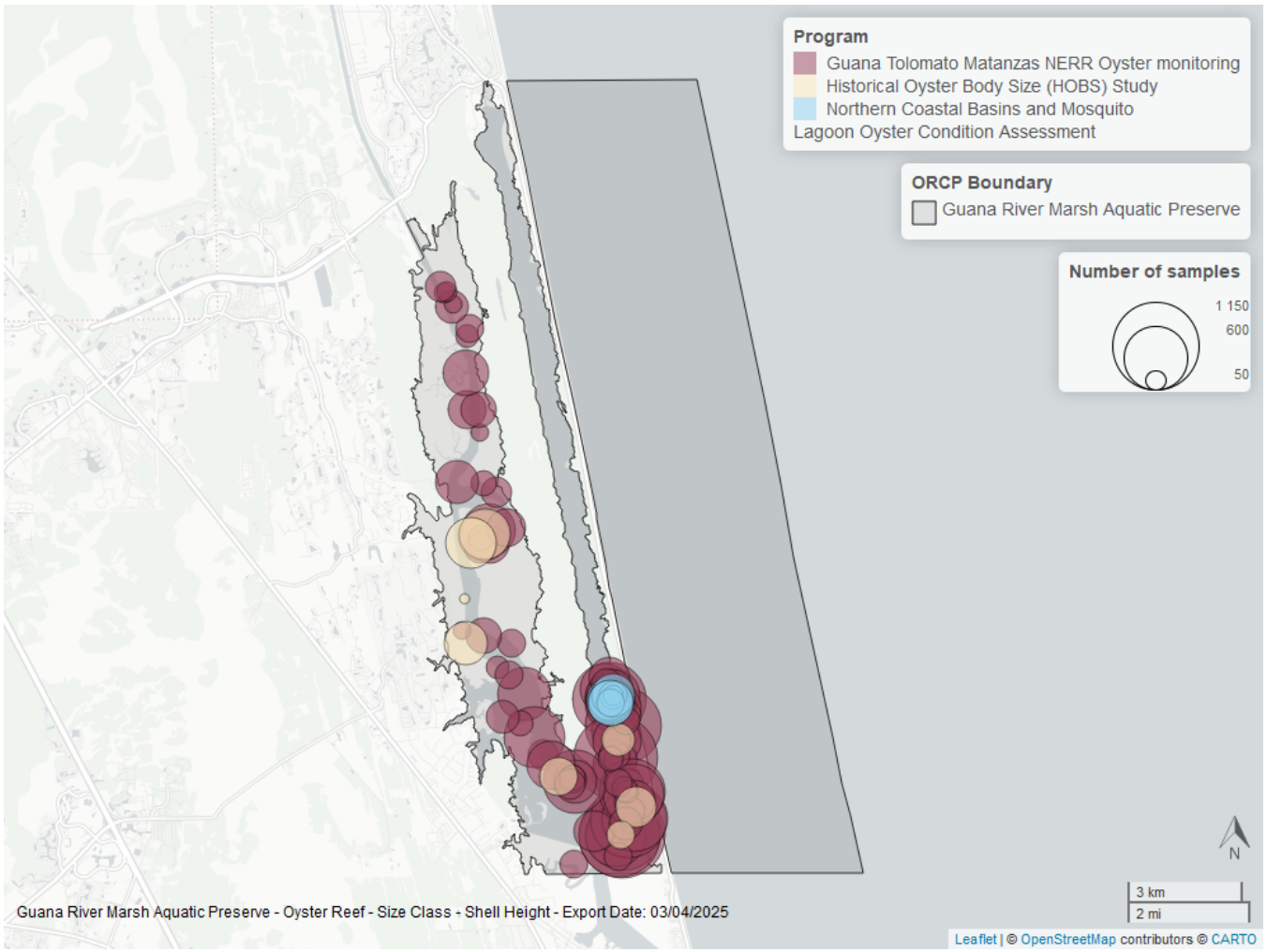

Figure 46: Map showing location of oyster shell height sampling locations within the boundaries of *Guana River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Species list

Avicennia germinans[1]	Hypericum sp.	Salicornia ambigua[1]
Bare substrate	Ilex vomitoria	Smilax bona-nox
Batis maritima[1]	Iva frutescens	Spartina alterniflora[1]
Coleataenia anceps	Juncus roemerianus[1]	Vitis sp.
Dichanthelium sp.	Quercus virginiana	Woody debris
Distichlis spicata[1]	Sabal palmetto	Avicennia germinans[1]

1 - Coastal Wetlands

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