Gasparilla Sound-Charlotte Harbor Aquatic Preserve

SEACAR Habitat Analyses

Last compiled on 22 May, 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

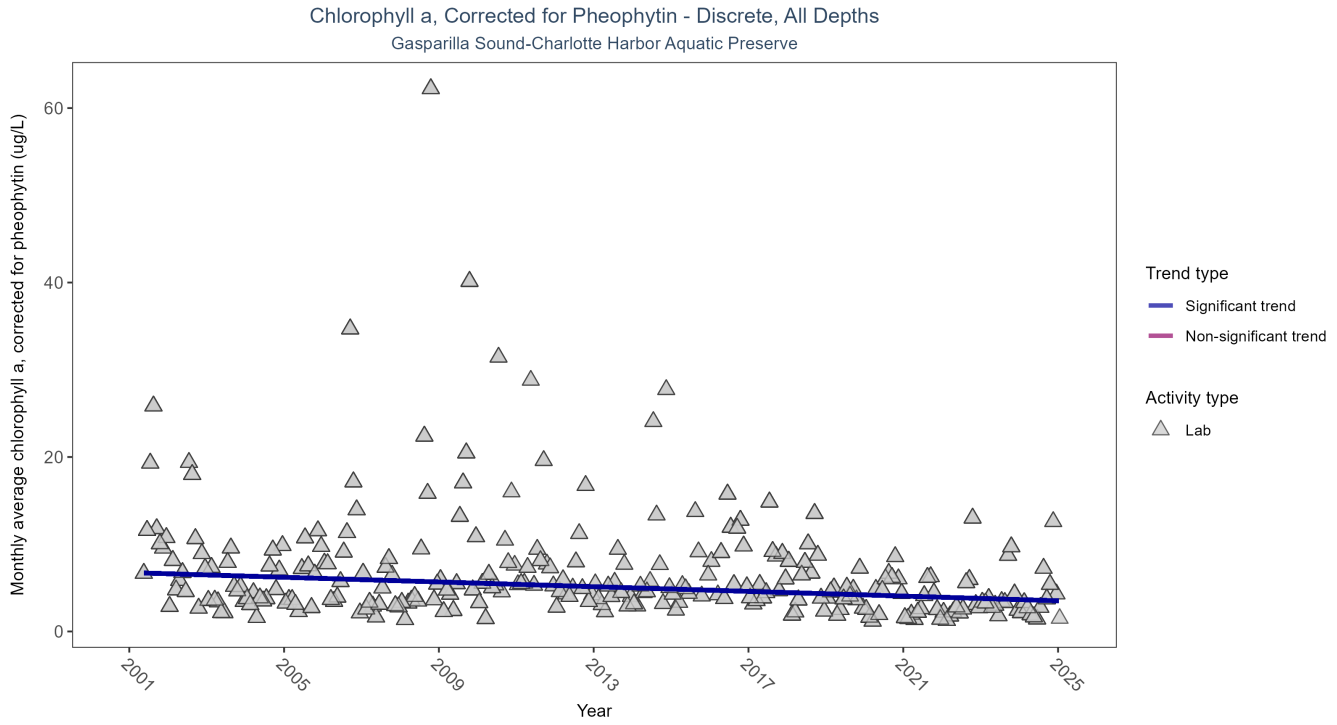

Figure 1: Scatter plot of monthly average levels of chlorophyll a, corrected for pheophytin, over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed chlorophyll a (triangles) 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 decreasing trend	4659	25	2001 - 2025	3.71	-0.2513	6.7517	-0.1347	0

Monthly average chlorophyll a, corrected for pheophytin, decreased by 0.13 µg/L per year, indicating an increase in water clarity.

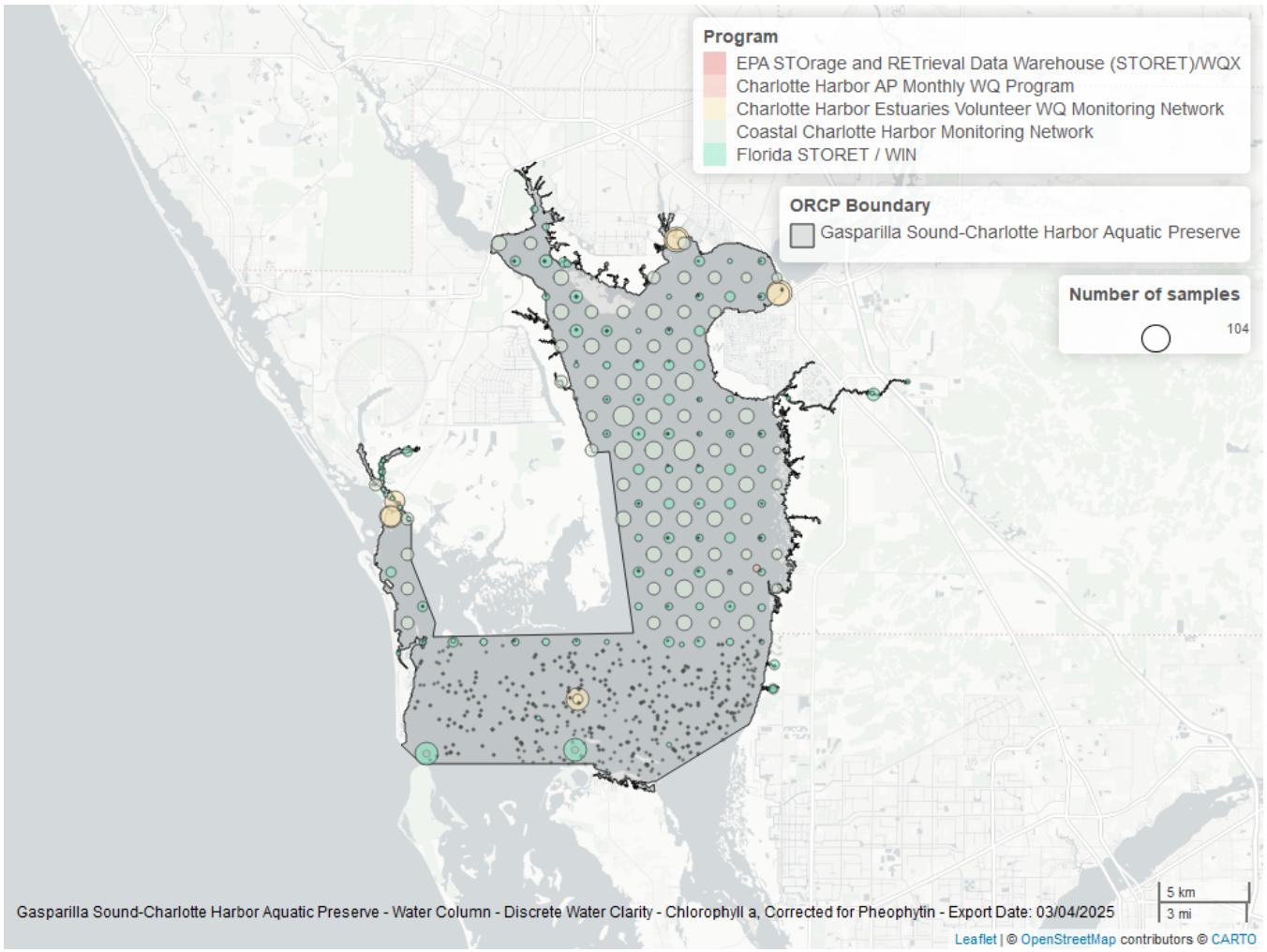

Figure 2: Map showing location of discrete water quality sampling locations within the boundaries of *Gasparilla Sound-Charlotte Harbor Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

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

ProgramID	*N_Data*	*YearMin*	*YearMax*
513	2619	2001	2024
5002	1347	2001	2024
476	644	2008	2024
103	88	2020	2021
5028	12	2024	2025

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[1]
476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network[2]
513 - Coastal Charlotte Harbor Monitoring Network[3]
5002 - Florida STORET / WIN[4]
5028 - Charlotte Harbor Aquatic Preserves Monthly Water Quality Program[5]

Chlorophyll a, Uncorrected for Pheophytin - Discrete

Seasonal Kendall-Tau Trend Analysis

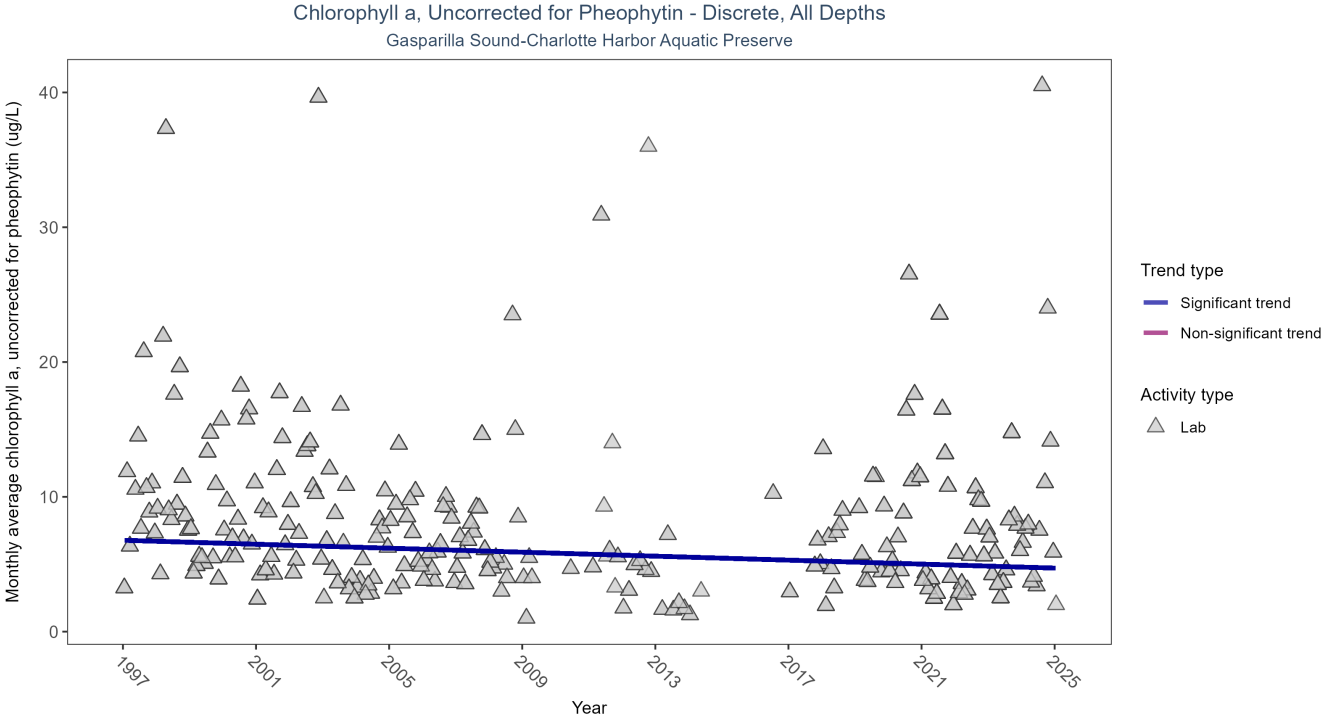

Figure 3: Scatter plot of monthly average levels of chlorophyll a, uncorrected for pheophytin, over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed chlorophyll a (triangles) 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 decreasing trend	2499	28	1997 - 2025	4.75	-0.1548	6.7786	-0.0737	0.0008

Monthly average chlorophyll a, uncorrected for pheophytin, decreased by 0.07 µg/L per year, indicating an increase in water clarity.

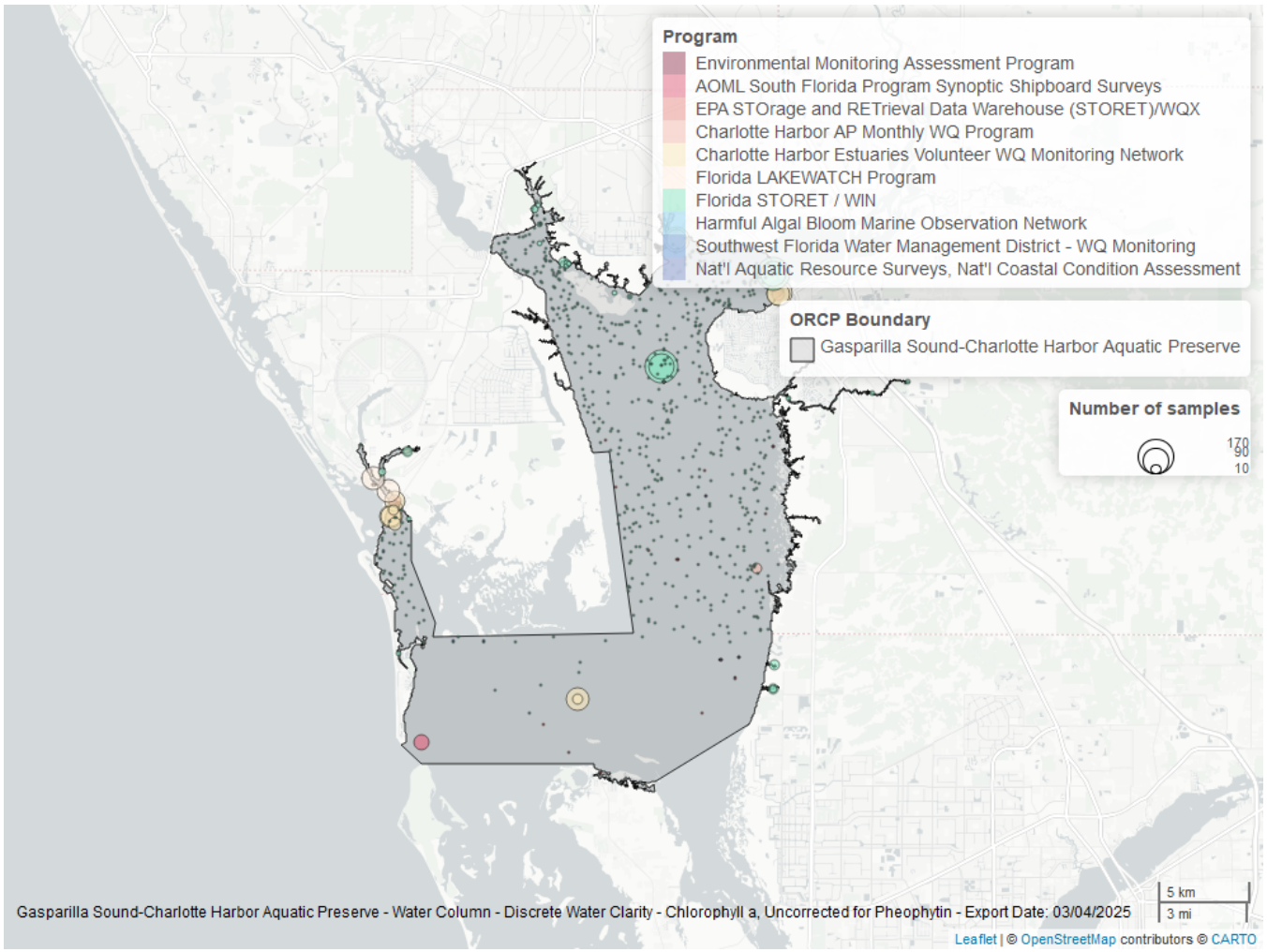

Figure 4: Map showing location of discrete water quality sampling locations within the boundaries of *Gasparilla Sound-Charlotte Harbor Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

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

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	1529	1997	2024
476	693	1998	2024
514	165	2000	2009
103	129	2000	2022
3	40	2001	2010
5028	17	2024	2025
95	7	2003	2010
115	6	2000	2004
118	5	2000	2010
479	2	2002	2002

Program names:

3 - Atlantic Oceanographic and Meteorological Laboratory (AOML) South Florida Program Synoptic Shipboard Surveys[6]

95 - Harmful Algal Bloom Marine Observation Network[7]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[1]
115 - Environmental Monitoring Assessment Program[8]
118 - National Aquatic Resource Surveys, National Coastal Condition Assessment[9]
476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network[2]
479 - Southwest Florida Water Management District - Water Quality Monitoring[10]
514 - Florida LAKEWATCH Program[11]
5002 - Florida STORET / WIN[4]
5028 - Charlotte Harbor Aquatic Preserves Monthly Water Quality Program[5]

Colored Dissolved Organic Matter - Discrete

Seasonal Kendall-Tau Trend Analysis

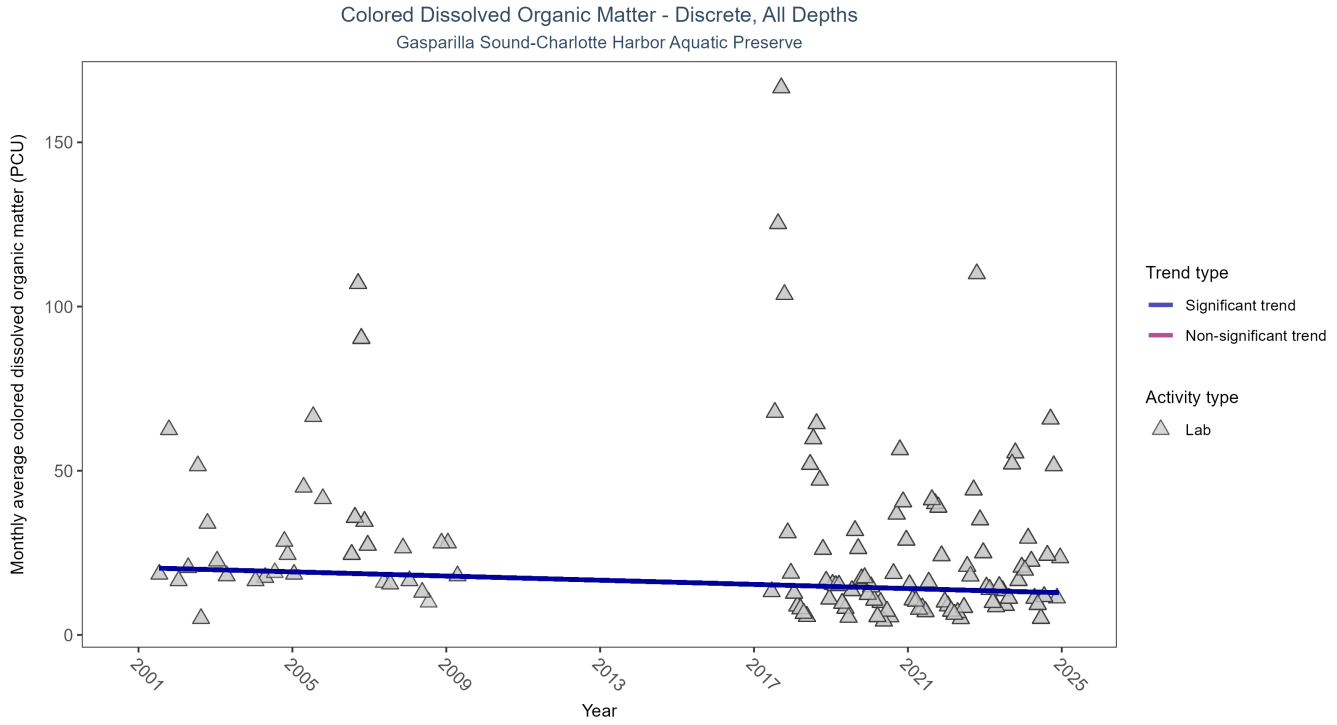

Figure 5: Scatter plot of monthly average colored dissolved organic matter (CDOM) over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed CDOM (triangles) is included in the 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	Significantly decreasing trend	1228	17	2001 - 2024	13.55	-0.1386	20.493	-0.3188	0.0166

Monthly average colored dissolved organic matter decreased by 0.32 PCU per year, indicating an increase in water clarity.

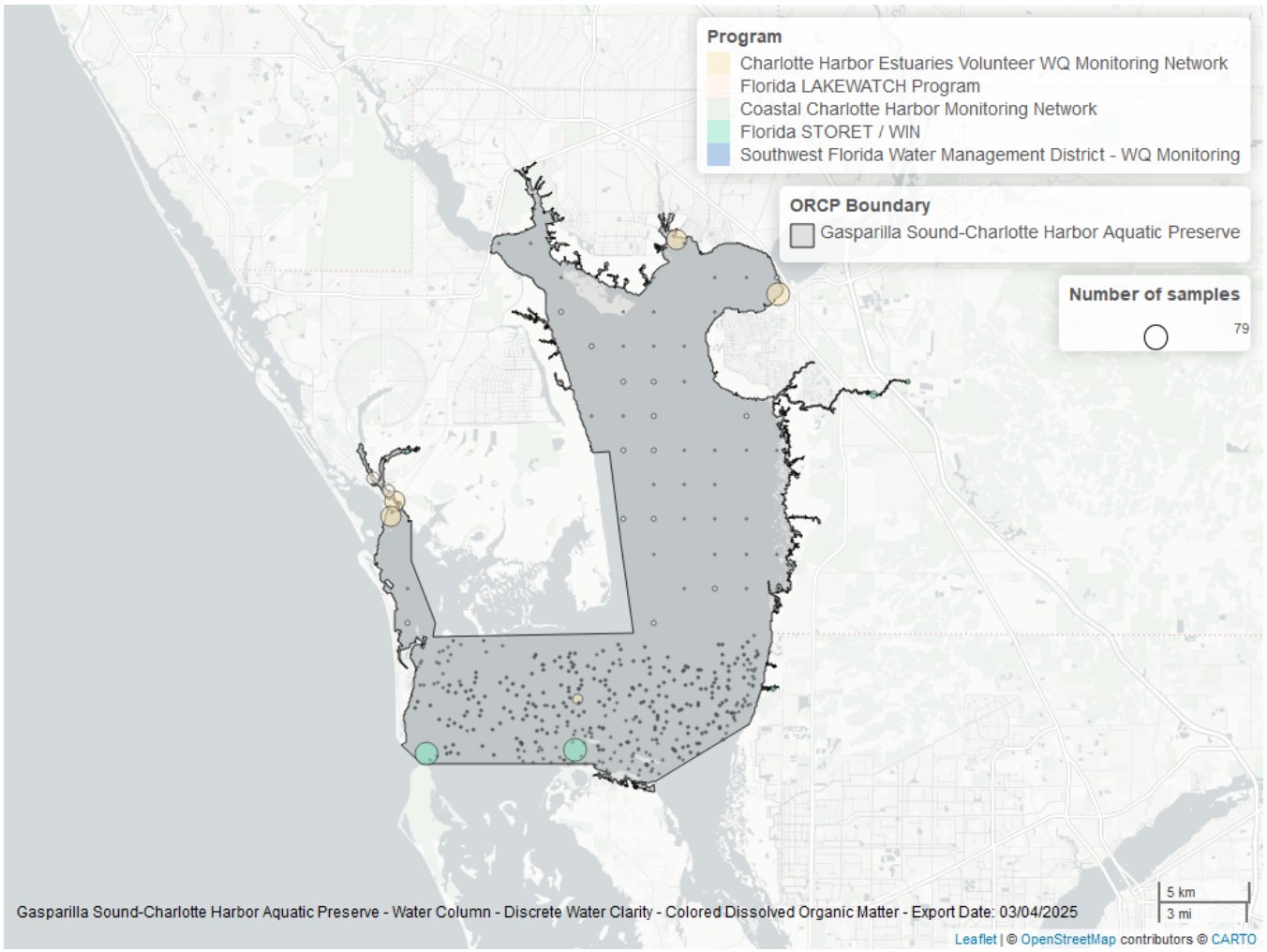

Figure 6: Map showing location of discrete water quality sampling locations within the boundaries of *Gasparilla Sound-Charlotte Harbor Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 11: Programs contributing data for Colored Dissolved Organic Matter

ProgramID	*N_Data*	*YearMin*	*YearMax*
513	712	2006	2024
476	280	2017	2024
5002	188	2018	2024
514	49	2001	2009
479	2	2002	2002

Program names:

476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network[2]
479 - Southwest Florida Water Management District - Water Quality Monitoring[10]
513 - Coastal Charlotte Harbor Monitoring Network[3]
514 - Florida LAKEWATCH Program[11]
5002 - Florida STORET / WIN[4]

Dissolved Oxygen - Discrete

Seasonal Kendall-Tau Trend Analysis

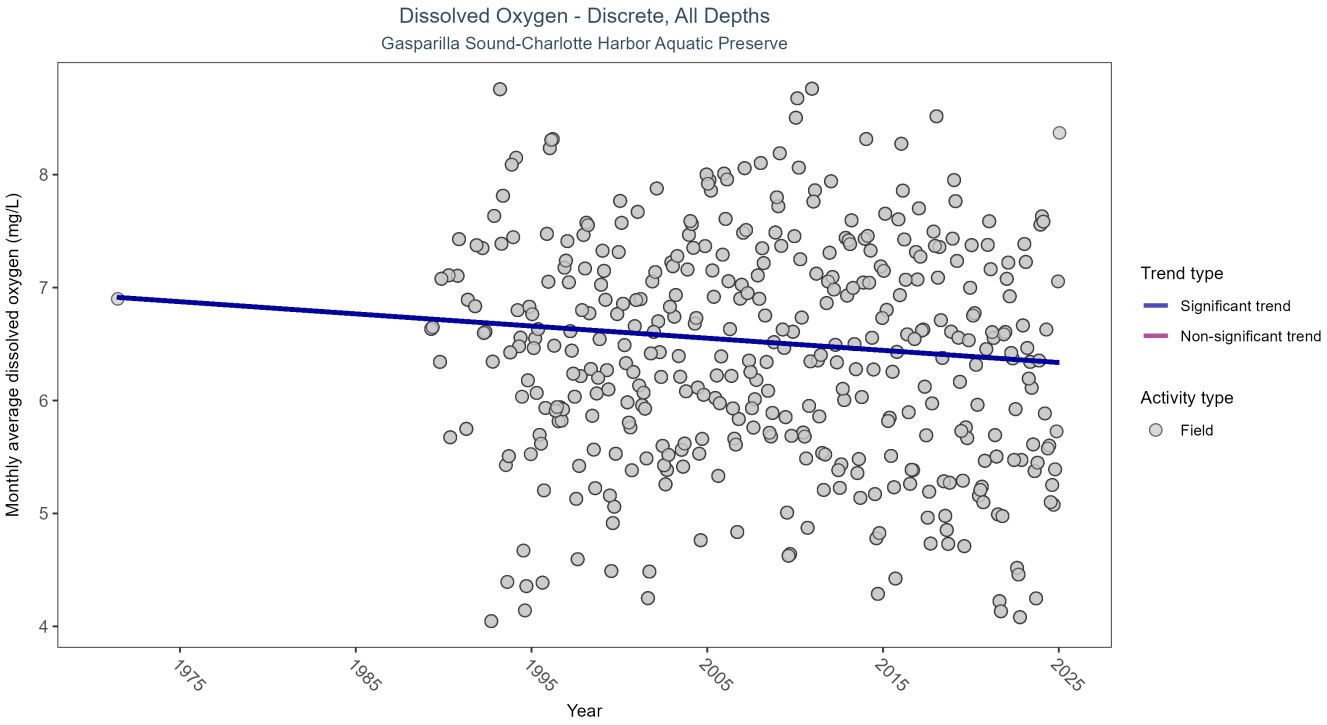

Figure 7: Scatter plot of monthly average dissolved oxygen over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only dissolved oxygen values measured in the field (circles) are included in the plot.

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	74596	38	1971 - 2025	6.55	-0.1343	6.9181	-0.0108	0.0001

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

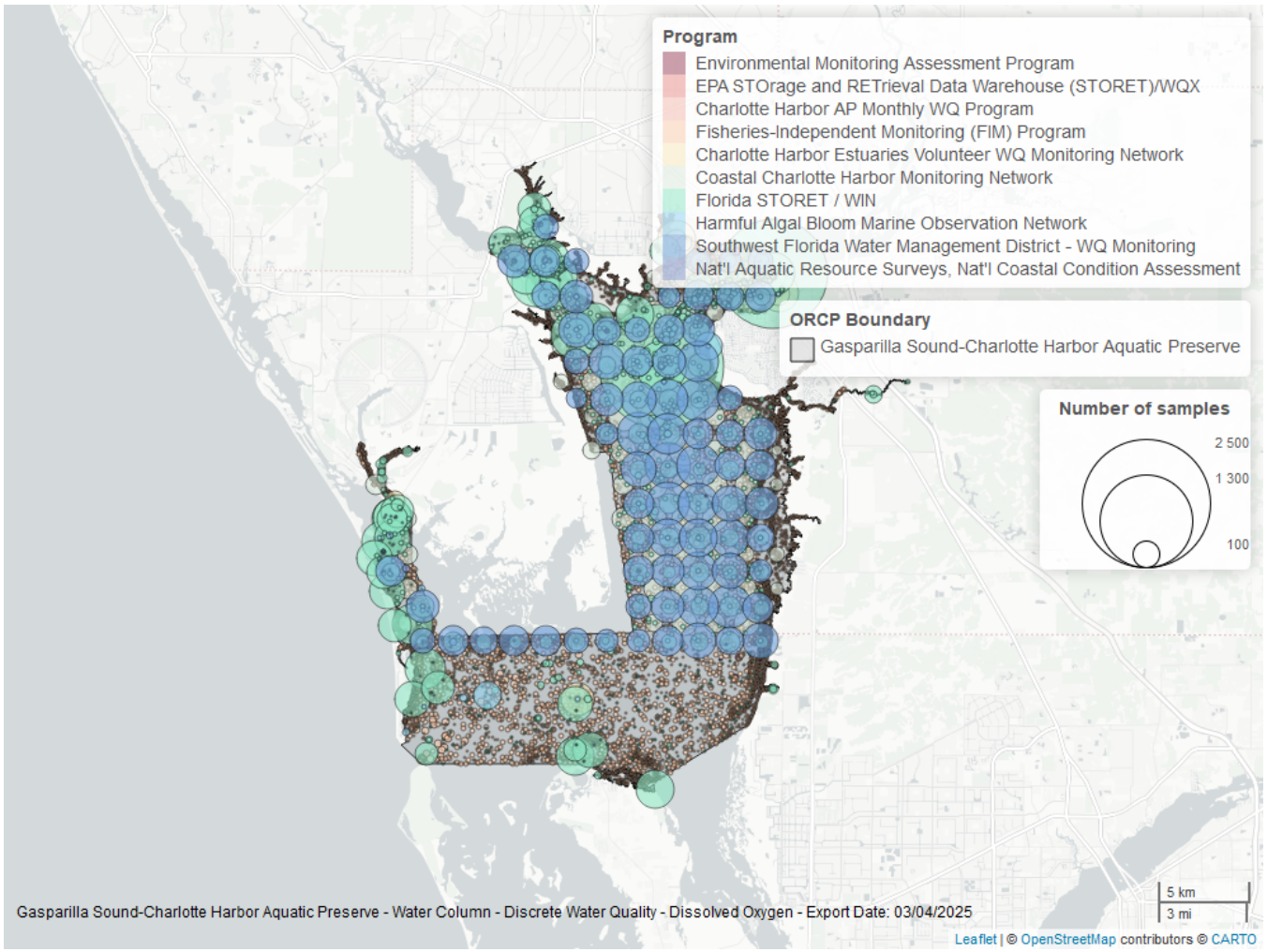

Figure 8: Map showing location of discrete water quality sampling locations within the boundaries of *Gasparilla Sound-Charlotte Harbor Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 13: Programs contributing data for Dissolved Oxygen

ProgramID	*N_Data*	*YearMin*	*YearMax*
69	35920	1989	2022
5002	19829	1993	2024
479	11958	2001	2016
513	5287	2001	2024
476	1107	1996	2024
95	397	1971	2018
103	151	2003	2022
118	32	2000	2020
115	27	2000	2004
5028	12	2024	2025

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program[12]
95 - Harmful Algal Bloom Marine Observation Network[7]

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[1]
115 - Environmental Monitoring Assessment Program[8]
118 - National Aquatic Resource Surveys, National Coastal Condition Assessment[9]
476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network[2]
479 - Southwest Florida Water Management District - Water Quality Monitoring[10]
513 - Coastal Charlotte Harbor Monitoring Network[3]
5002 - Florida STORET / WIN[4]
5028 - Charlotte Harbor Aquatic Preserves Monthly Water Quality Program[5]

Dissolved Oxygen Saturation - Discrete

Seasonal Kendall-Tau Trend Analysis

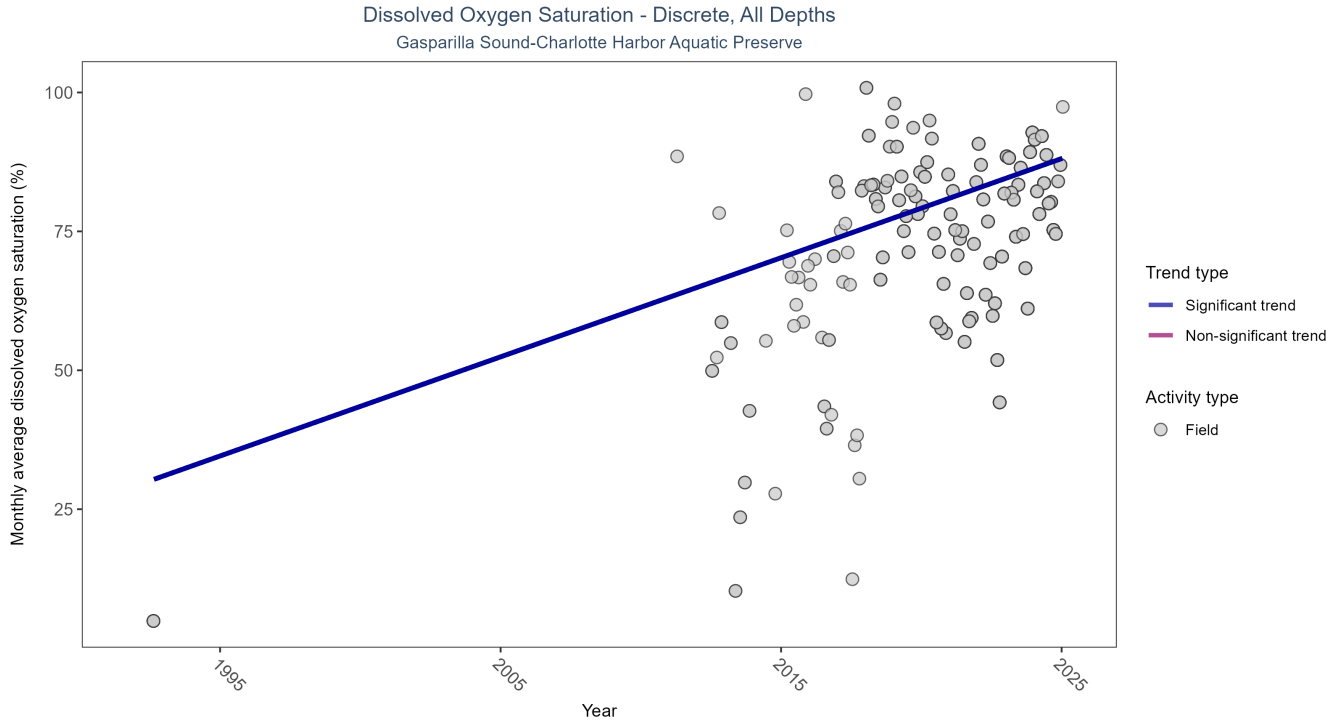

Figure 9: Scatter plot of monthly average dissolved oxygen saturation over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only dissolved oxygen saturation values measured in the field (circles) 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	828	16	1992 - 2025	82.95	0.3079	29.2273	1.784	0

Monthly average dissolved oxygen saturation increased by 1.78% per year.

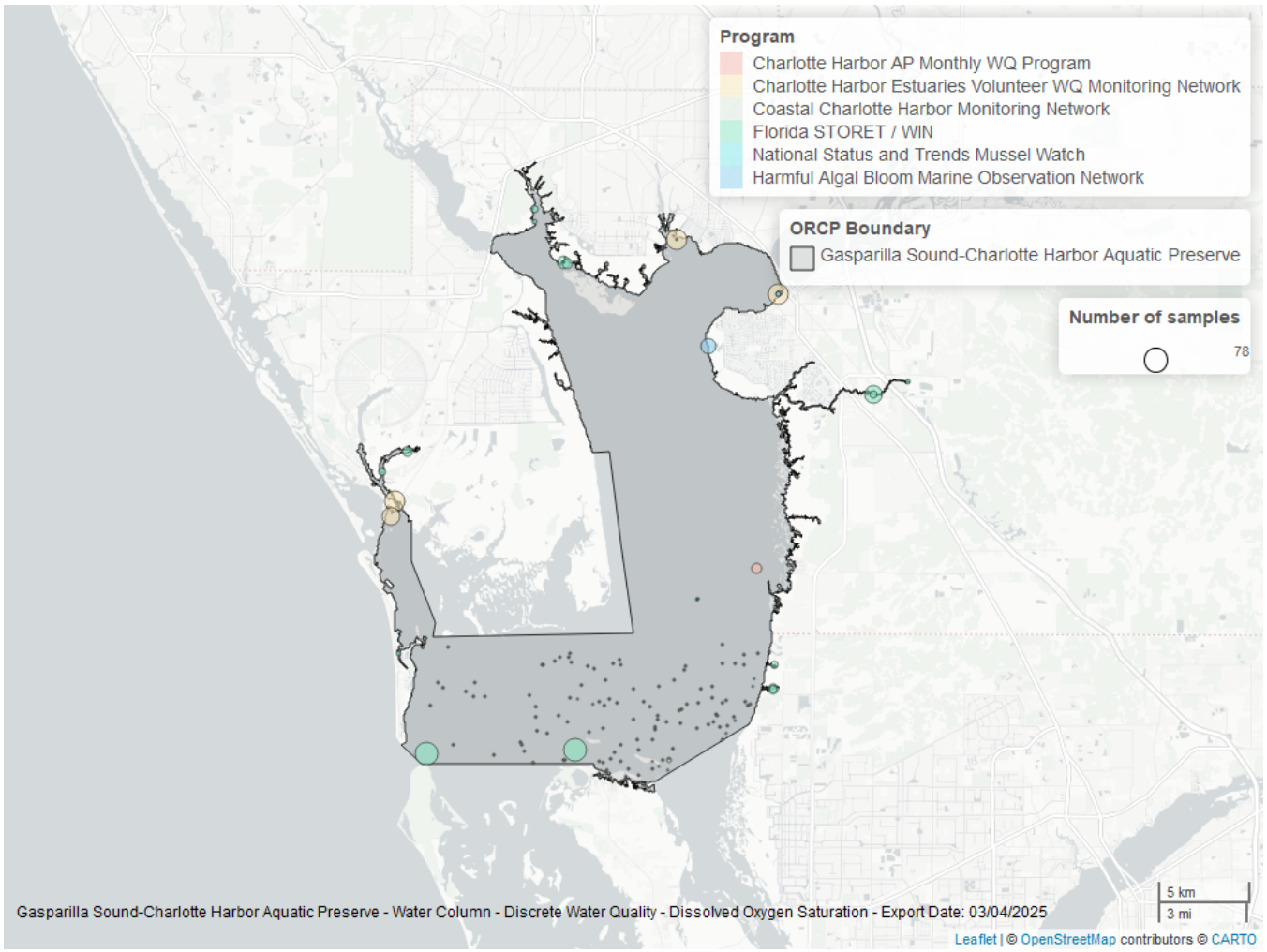

Figure 10: Map showing location of discrete water quality sampling locations within the boundaries of *Gasparilla Sound-Charlotte Harbor Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 15: Programs contributing data for Dissolved Oxygen Saturation

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	339	2012	2024
476	237	2016	2024
513	226	2020	2024
95	43	2011	2018
5028	14	2024	2025
102	6	1992	1992

Program names:

95 - Harmful Algal Bloom Marine Observation Network[7]
102 - National Status and Trends Mussel Watch[13]
476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network[2]
513 - Coastal Charlotte Harbor Monitoring Network[3]
5002 - Florida STORET / WIN[4]
5028 - Charlotte Harbor Aquatic Preserves Monthly Water Quality Program[5]

pH - Discrete

Seasonal Kendall-Tau Trend Analysis

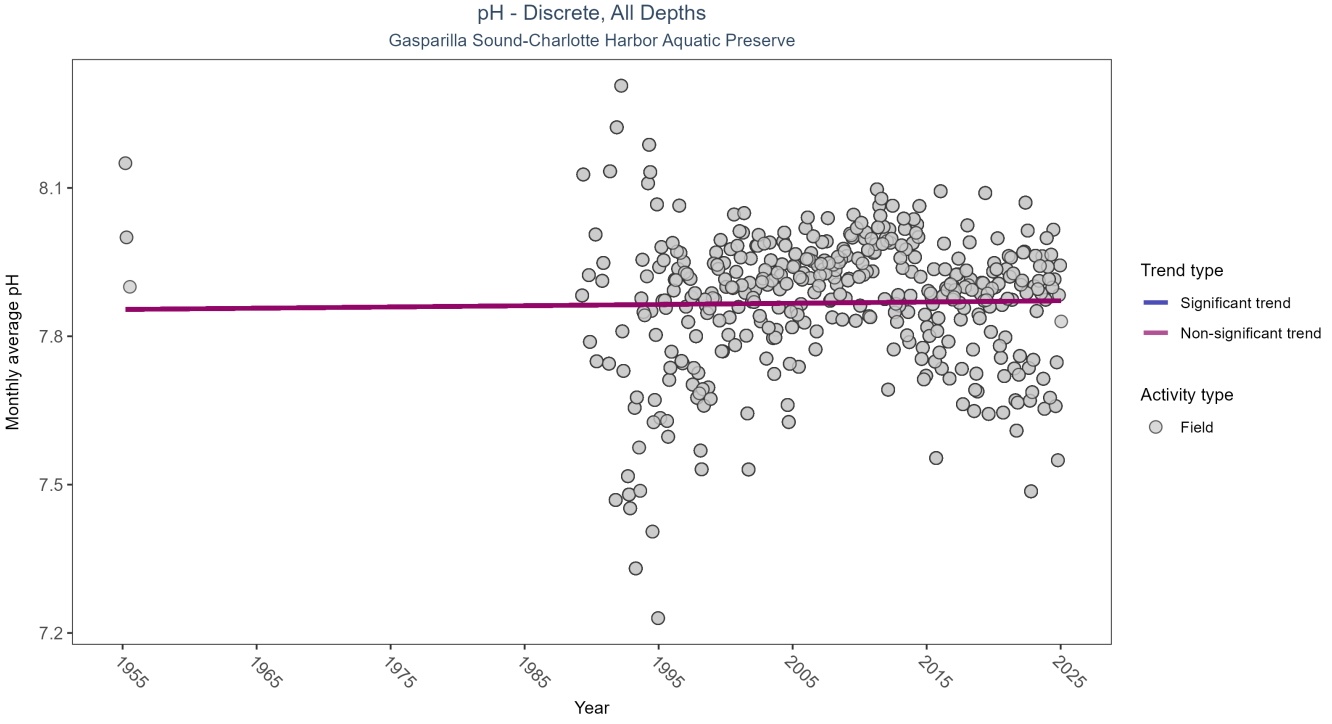

Figure 11: Scatter plot of monthly average pH over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only pH values measured in the field (circles) are included in the plot.

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	No significant trend	71238	38	1955 - 2025	7.91	0.0226	7.8542	0.0003	0.5928

pH showed no detectable trend between 1955 and 2025.

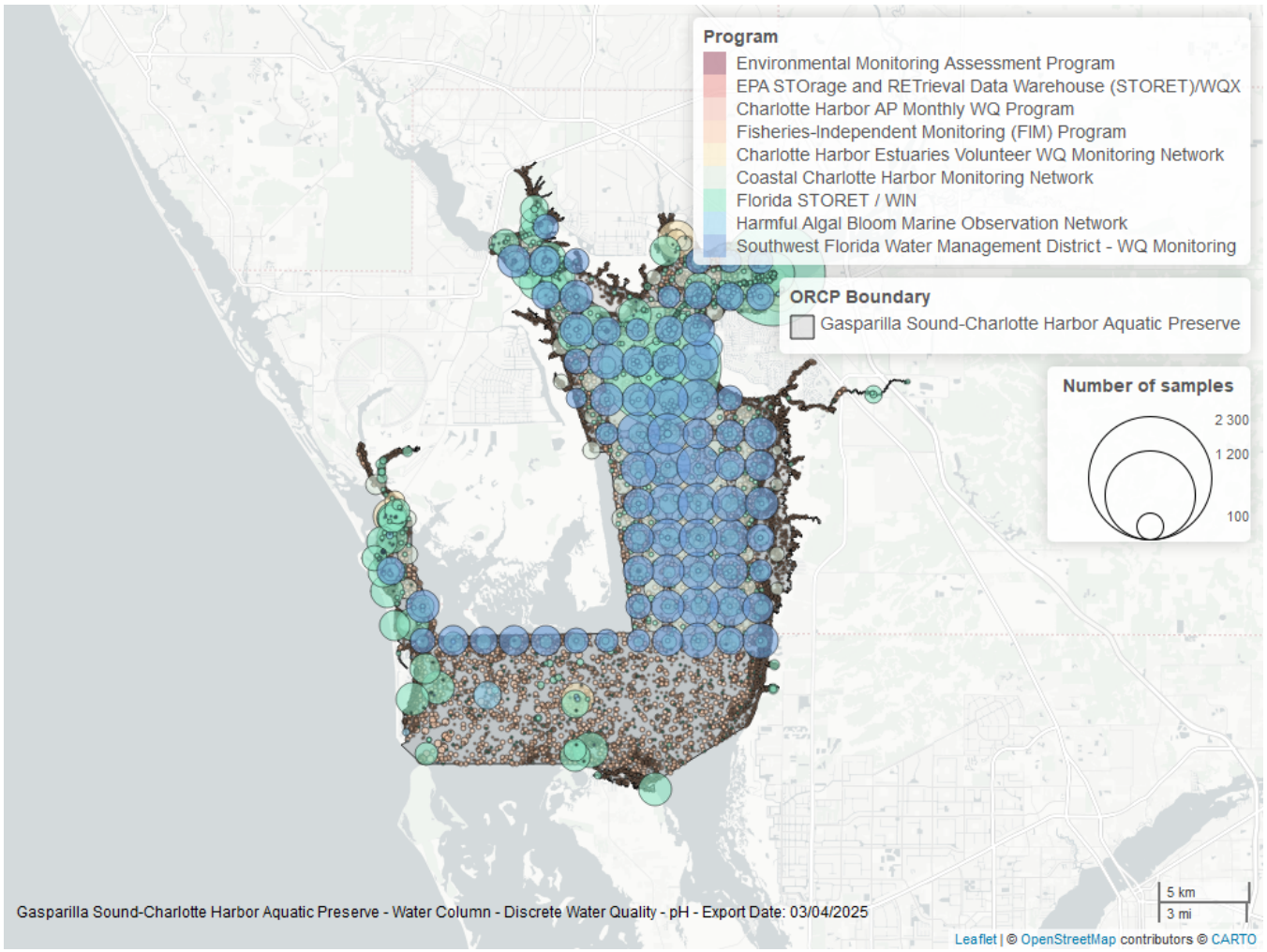

Figure 12: Map showing location of discrete water quality sampling locations within the boundaries of *Gasparilla Sound-Charlotte Harbor Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 17: Programs contributing data for pH

ProgramID	*N_Data*	*YearMin*	*YearMax*
69	35469	1989	2022
5002	17124	1993	2024
479	11746	2001	2016
513	5237	2001	2024
476	1140	1996	2024
95	365	1955	2018
103	151	2003	2022
115	27	2000	2004
5028	14	2024	2025

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program[12]
95 - Harmful Algal Bloom Marine Observation Network[7]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[1]

115 - Environmental Monitoring Assessment Program[8]
476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network[2]
479 - Southwest Florida Water Management District - Water Quality Monitoring[10]
513 - Coastal Charlotte Harbor Monitoring Network[3]
5002 - Florida STORET / WIN[4]
5028 - Charlotte Harbor Aquatic Preserves Monthly Water Quality Program[5]

Salinity - Discrete

Seasonal Kendall-Tau Trend Analysis

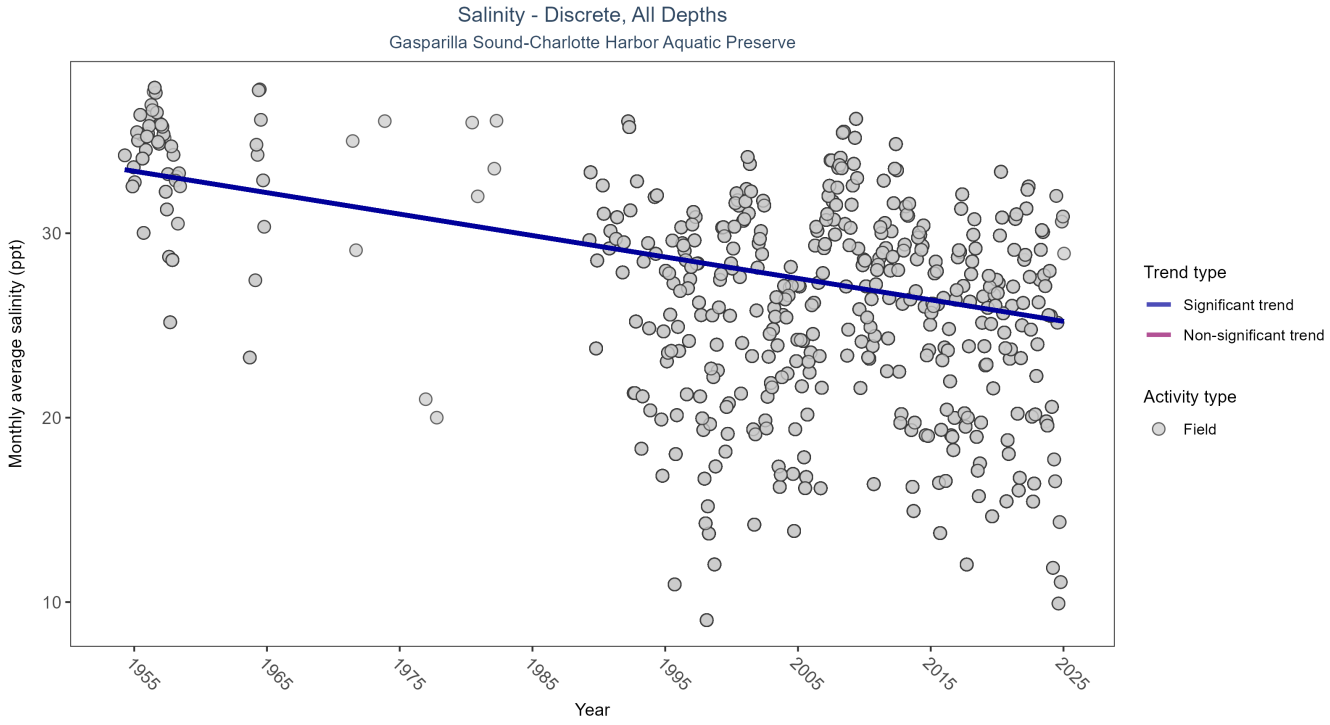

Figure 13: Scatter plot of monthly average salinity over time. If the time series included ten or more years of discrete observations, significant (blue) or non-significant (magenta) trend lines are also shown. Discrete salinity values derived from grab samples analyzed in the field (circles) or the 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	73087	50	1954 - 2025	26.7	-0.284	33.4792	-0.1163	0

Monthly average salinity decreased by 0.12 ppt per year.

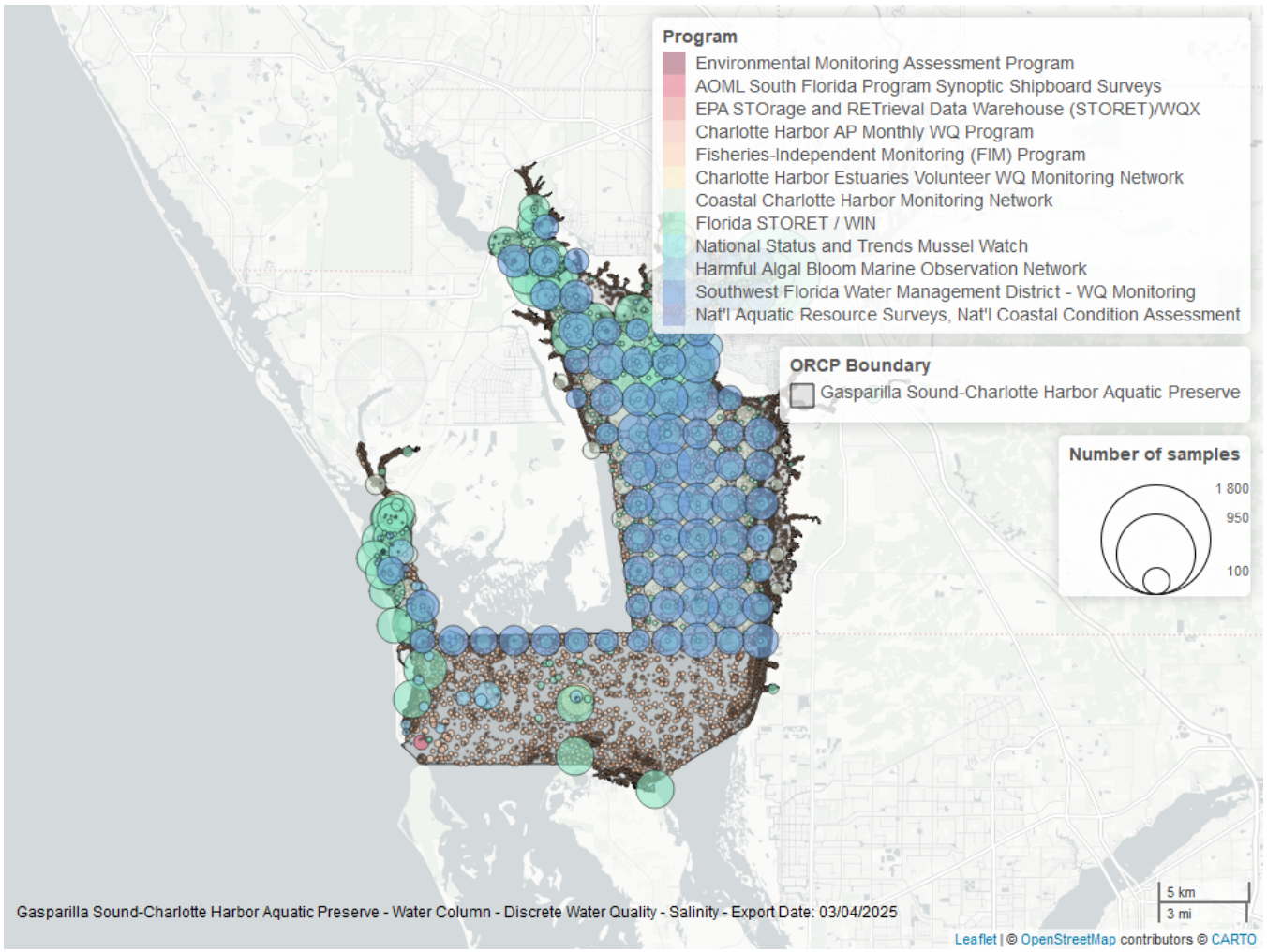

Figure 14: Map showing location of discrete water quality sampling locations within the boundaries of *Gasparilla Sound-Charlotte Harbor Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 19: Programs contributing data for Salinity

ProgramID	*N_Data*	*YearMin*	*YearMax*
69	36265	1989	2022
5002	17781	1995	2024
479	11924	2001	2016
513	5075	2001	2024
476	1135	1996	2024
95	802	1954	2018
3	42	2001	2010
115	27	2000	2004
118	26	2015	2020
5028	14	2024	2025
102	6	1992	1992
103	5	2003	2004

Program names:

3 - Atlantic Oceanographic and Meteorological Laboratory (AOML) South Florida Program Synoptic Shipboard Surveys[6]
69 - Fisheries-Independent Monitoring (FIM) Program[12]
95 - Harmful Algal Bloom Marine Observation Network[7]
102 - National Status and Trends Mussel Watch[13]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[1]
115 - Environmental Monitoring Assessment Program[8]
118 - National Aquatic Resource Surveys, National Coastal Condition Assessment[9]
476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network[2]
479 - Southwest Florida Water Management District - Water Quality Monitoring[10]
513 - Coastal Charlotte Harbor Monitoring Network[3]
5002 - Florida STORET / WIN[4]
5028 - Charlotte Harbor Aquatic Preserves Monthly Water Quality Program[5]

Secchi Depth - Discrete

Seasonal Kendall-Tau Trend Analysis

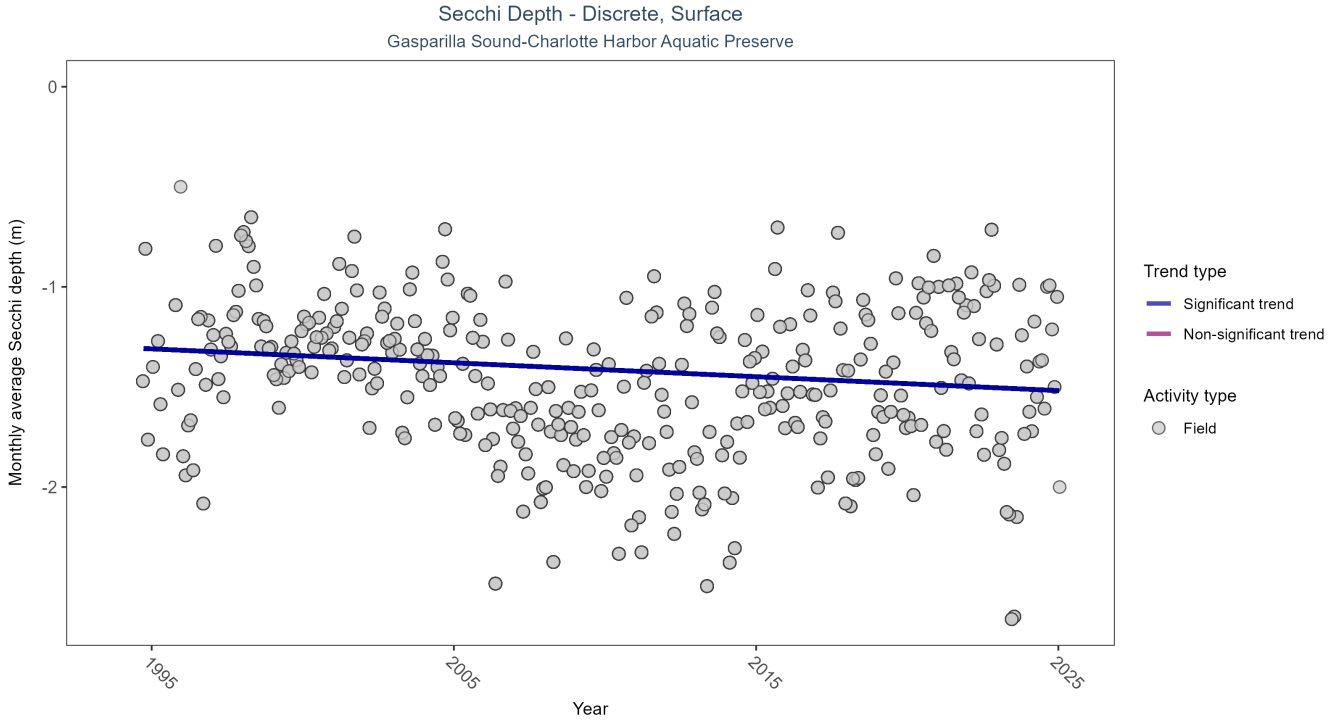

Figure 15: Scatter plot of monthly average Secchi depth over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Secchi depth is only measured in the field (circles).

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	Significantly decreasing trend	44439	32	1994 - 2025	-1.2	-0.1223	-1.3027	-0.0069	0.0011

Monthly average Secchi depth became deeper by 0.01 m per year, indicating an increase in water clarity.

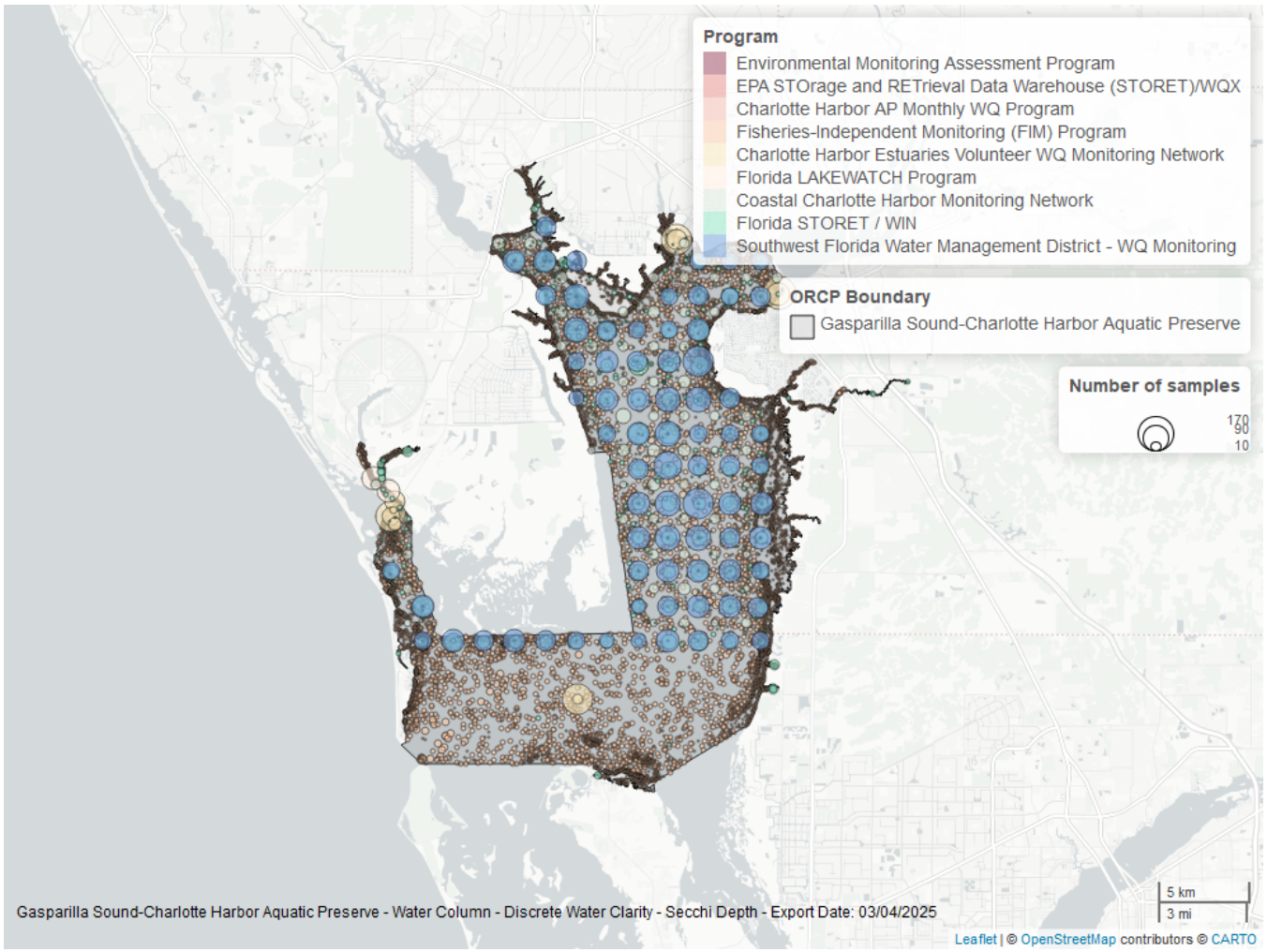

Figure 16: Map showing location of discrete water quality sampling locations within the boundaries of *Gasparilla Sound-Charlotte Harbor Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 21: Programs contributing data for Secchi Depth

ProgramID	*N_Data*	*YearMin*	*YearMax*
69	33261	1994	2022
479	5322	2001	2016
5002	3630	2003	2024
513	1074	2001	2024
476	921	1996	2024
514	159	2000	2009
103	65	2020	2022
5028	12	2024	2025
115	5	2000	2004

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program[12]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[1]
115 - Environmental Monitoring Assessment Program[8]

476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network[2]
479 - Southwest Florida Water Management District - Water Quality Monitoring[10]
513 - Coastal Charlotte Harbor Monitoring Network[3]
514 - Florida LAKEWATCH Program[11]
5002 - Florida STORET / WIN[4]
5028 - Charlotte Harbor Aquatic Preserves Monthly Water Quality Program[5]

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

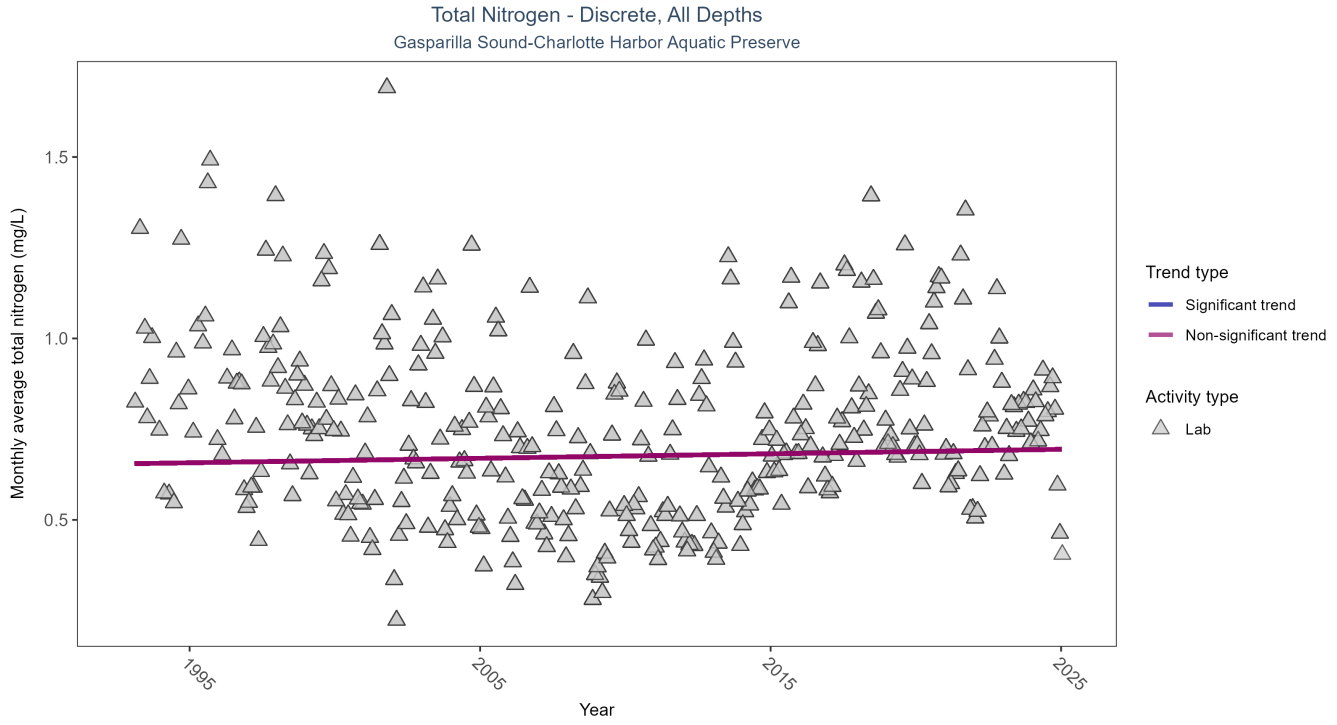

Figure 17: Scatter plot of monthly average total nitrogen over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only nitrogen values obtained from laboratory analyses (triangles) are included in the 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	10753	33	1993 - 2025	0.663	0.0419	0.6549	0.0012	0.284

Total nitrogen showed no detectable trend between 1993 and 2025.

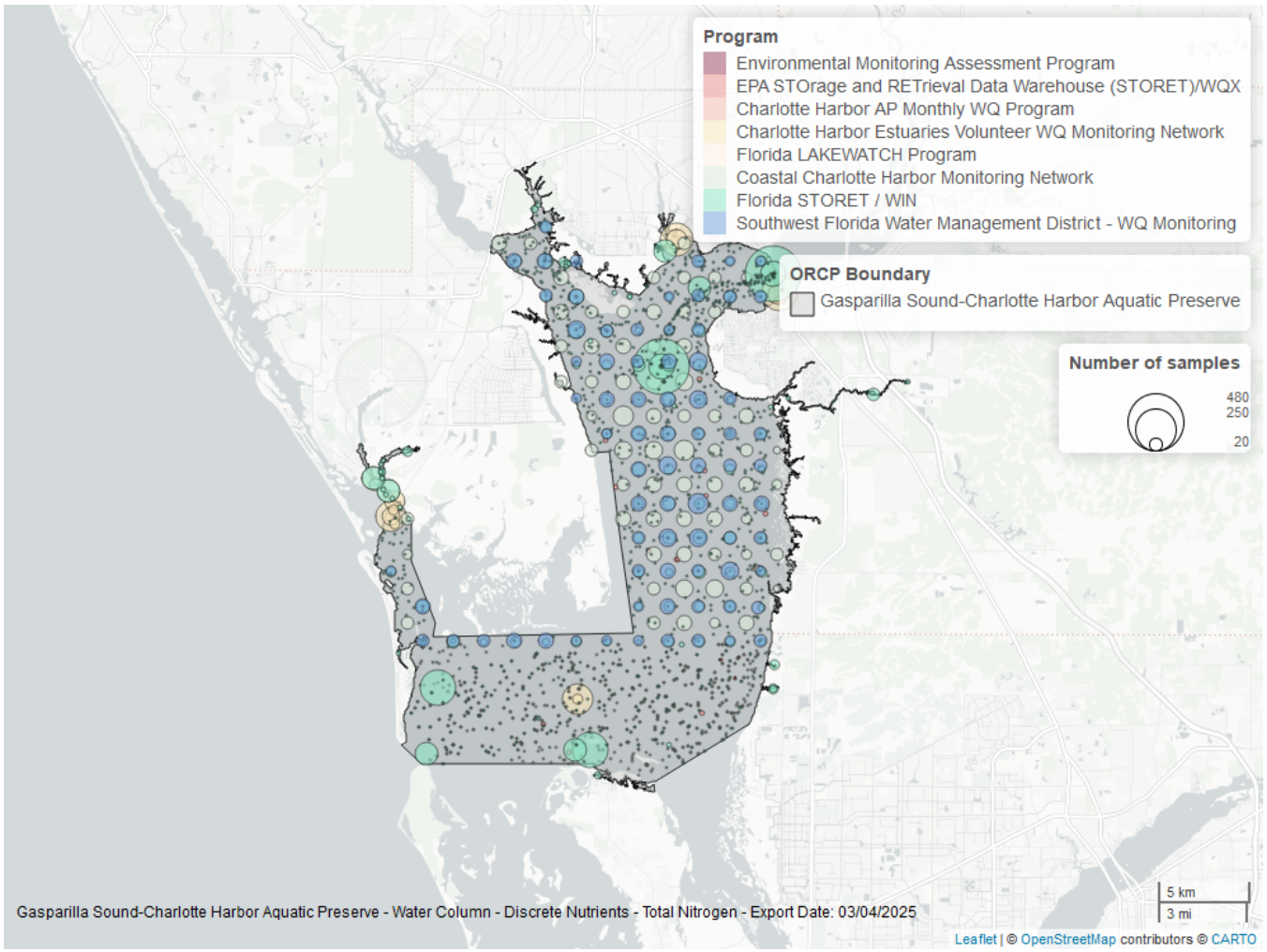

Figure 18: Map showing location of discrete water quality sampling locations within the boundaries of *Gasparilla Sound-Charlotte Harbor Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 23: Programs contributing data for Total Nitrogen

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	4856	1993	2024
513	2605	2001	2024
479	2134	2002	2016
476	974	1998	2024
514	169	2000	2009
103	43	2000	2006
5028	12	2024	2025
115	4	2000	2003

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[1]
115 - Environmental Monitoring Assessment Program[8]
476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network[2]
479 - Southwest Florida Water Management District - Water Quality Monitoring[10]

513 - Coastal Charlotte Harbor Monitoring Network[3]
514 - Florida LAKEWATCH Program[11]
5002 - Florida STORET / WIN[4]
5028 - Charlotte Harbor Aquatic Preserves Monthly Water Quality Program[5]

Total Phosphorus - Discrete

Seasonal Kendall-Tau Trend Analysis

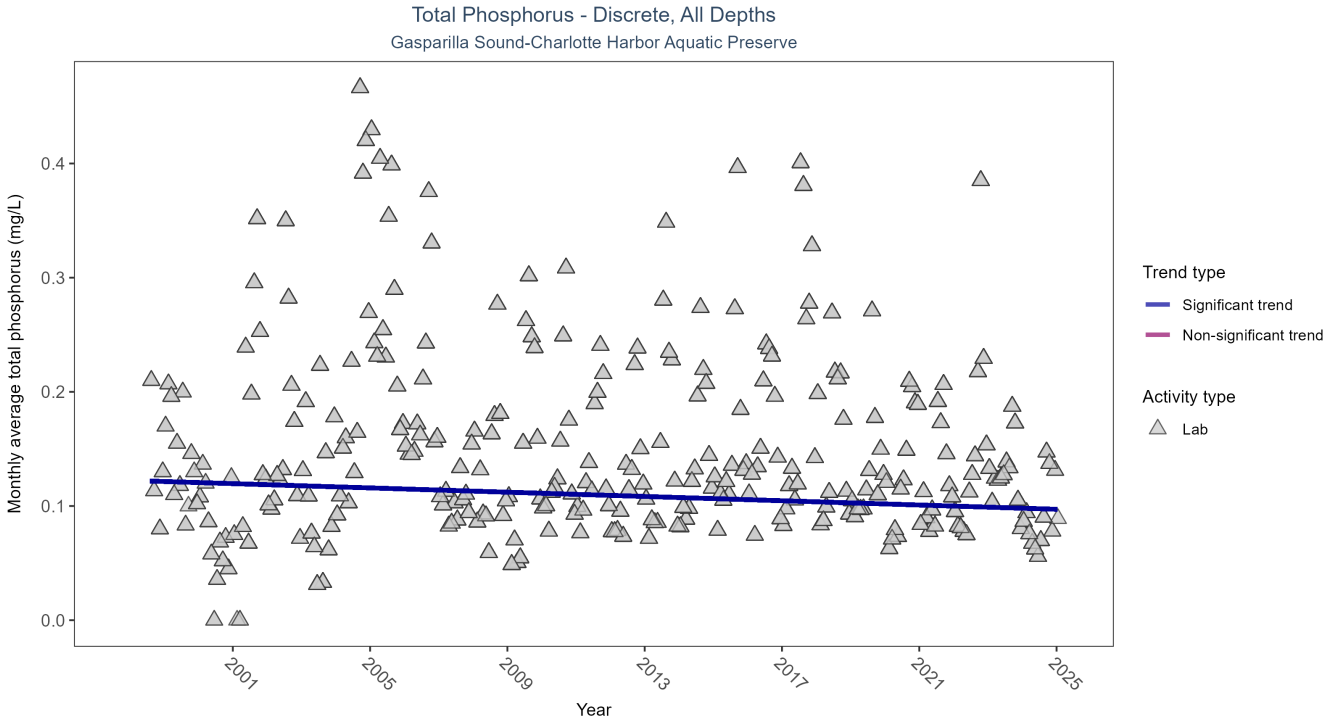

Figure 19: Scatter plot of monthly average total phosphorus over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only phosphorus values obtained from laboratory analyses (triangles) are included 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	8831	28	1998 - 2025	0.118	-0.1007	0.1224	-0.0009	0.0127

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

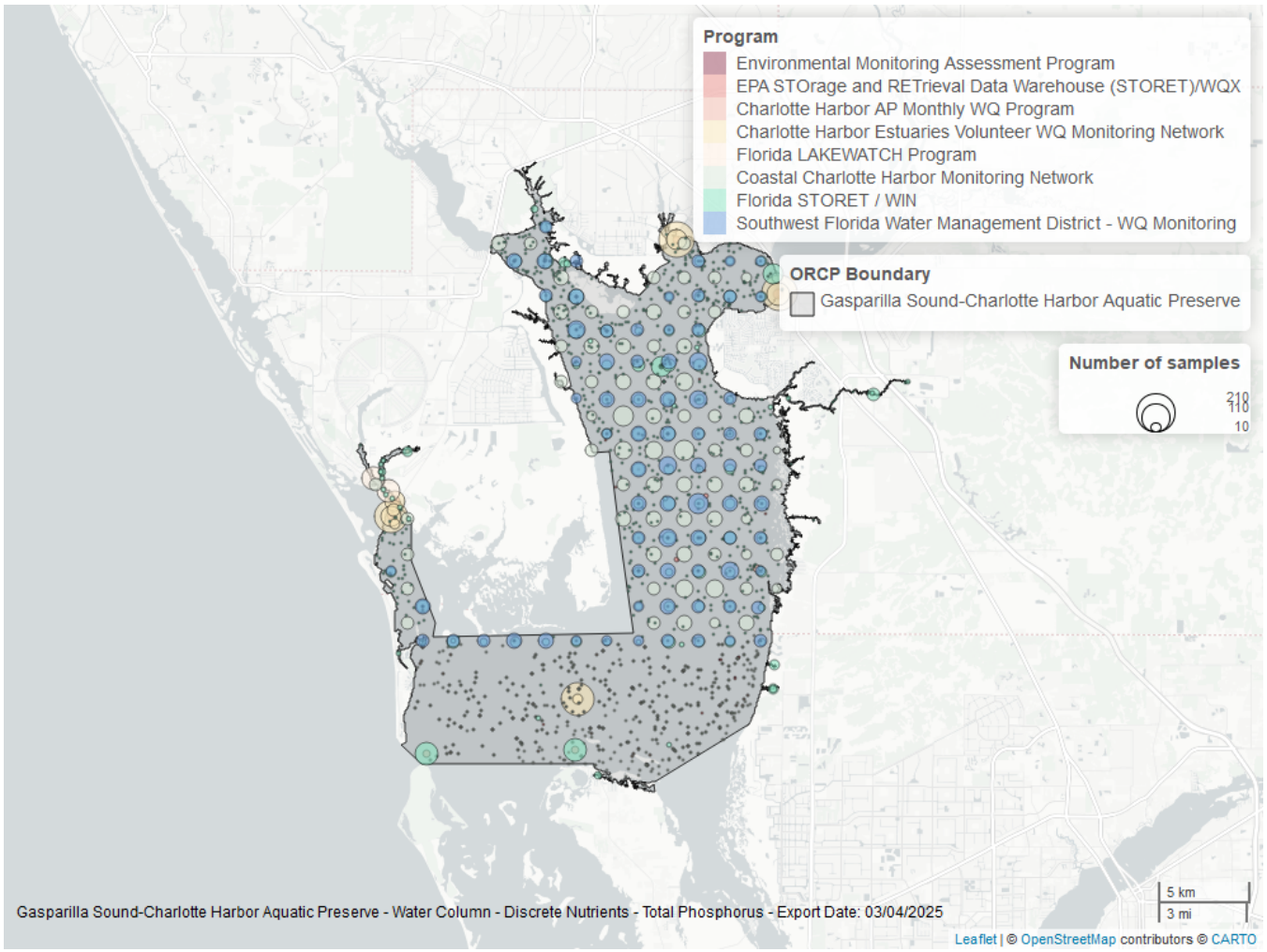

Figure 20: Map showing location of discrete water quality sampling locations within the boundaries of *Gasparilla Sound-Charlotte Harbor Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 25: Programs contributing data for Total Phosphorus

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	2710	2001	2024
513	2631	2001	2024
479	2118	2002	2016
476	1065	1998	2024
103	185	2000	2022
514	169	2000	2009
5028	12	2024	2025
115	4	2000	2003

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[1]
115 - Environmental Monitoring Assessment Program[8]
476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network[2]
479 - Southwest Florida Water Management District - Water Quality Monitoring[10]

513 - Coastal Charlotte Harbor Monitoring Network[3]
514 - Florida LAKEWATCH Program[11]
5002 - Florida STORET / WIN[4]
5028 - Charlotte Harbor Aquatic Preserves Monthly Water Quality Program[5]

Total Suspended Solids - Discrete

Seasonal Kendall-Tau Trend Analysis

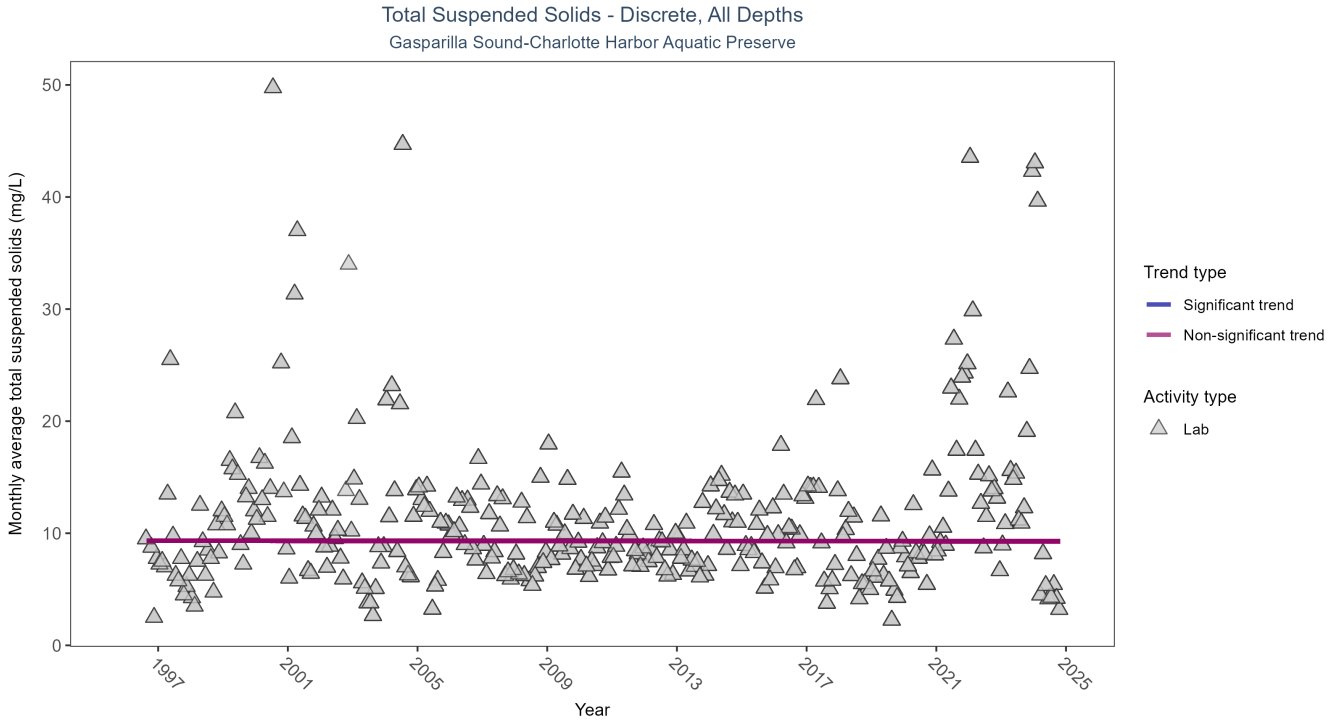

Figure 21: Scatter plot of monthly average total suspended solids (TSS) over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only TSS values obtained from laboratory analyses (triangles) are included 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	No significant trend	8788	29	1996 - 2024	7.25	-0.0022	9.3404	-0.0019	0.9591

Total suspended solids showed no detectable trend between 1996 and 2024.

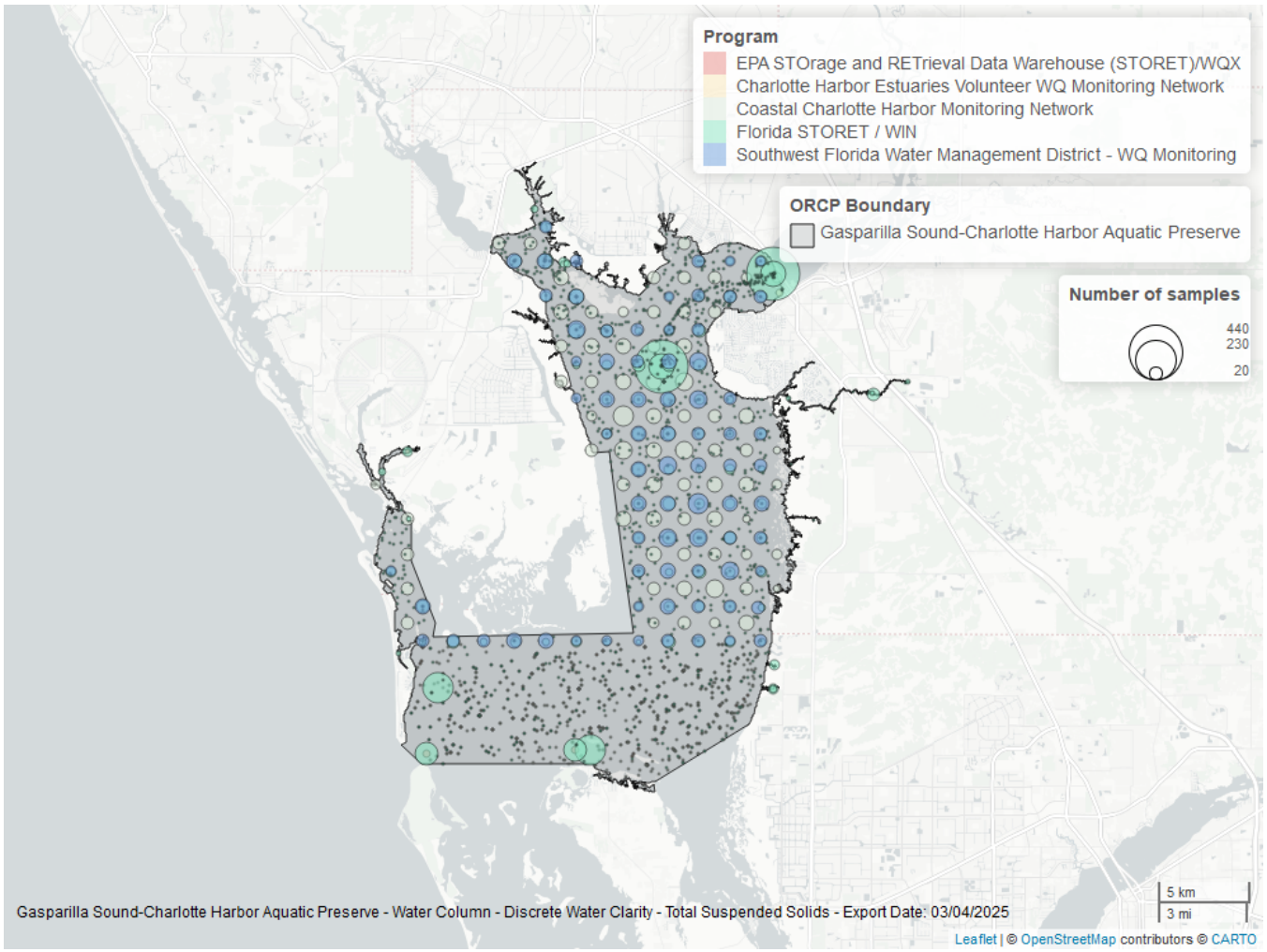

Figure 22: Map showing location of discrete water quality sampling locations within the boundaries of *Gasparilla Sound-Charlotte Harbor Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 27: Programs contributing data for Total Suspended Solids

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	4221	1996	2024
513	2521	2001	2024
479	2137	2002	2016
103	115	2020	2021
476	10	2016	2016

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[1]
476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network[2]
479 - Southwest Florida Water Management District - Water Quality Monitoring[10]
513 - Coastal Charlotte Harbor Monitoring Network[3]
5002 - Florida STORET / WIN[4]

Turbidity - Discrete

Seasonal Kendall-Tau Trend Analysis

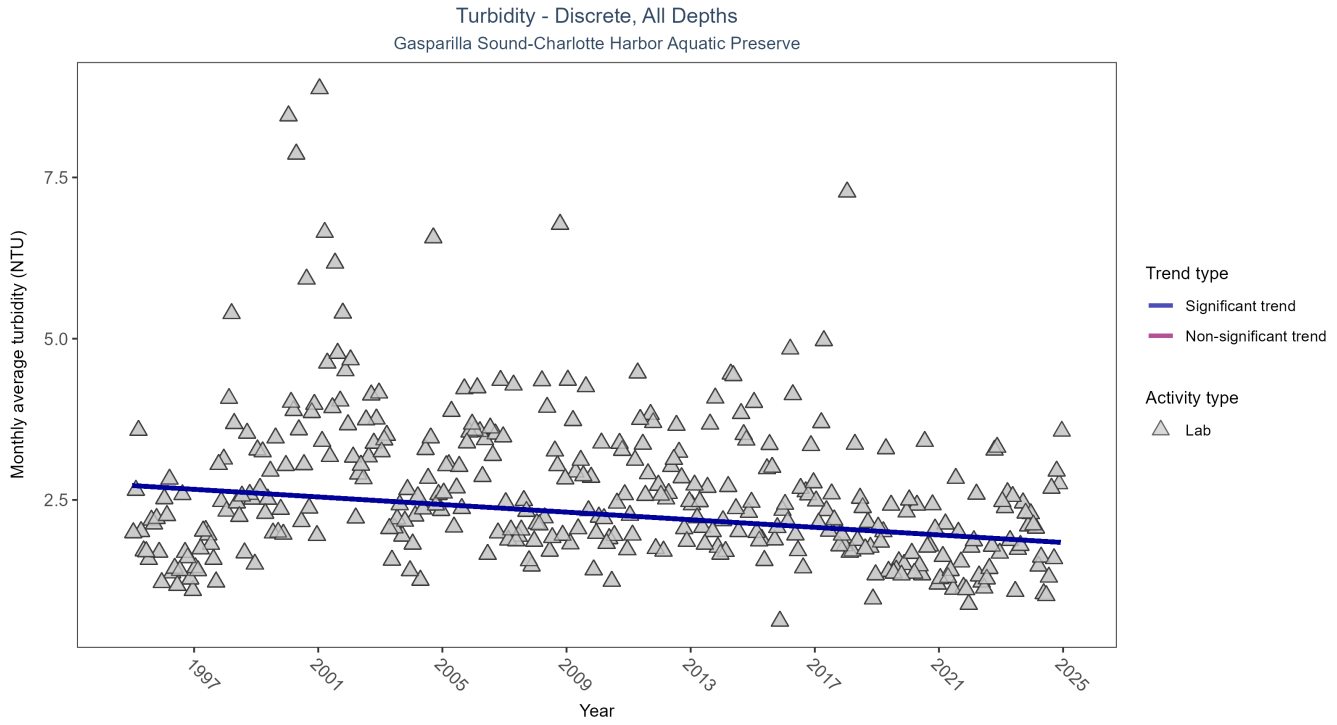

Figure 23: Scatter plot of monthly average turbidity over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only turbidity values measured in the laboratory (triangles) are included in the plot.

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 decreasing trend	14679	30	1995 - 2024	1.96	-0.1916	2.723	-0.0295	0

Monthly average turbidity decreased by 0.03 NTU per year, indicating an increase in water clarity.

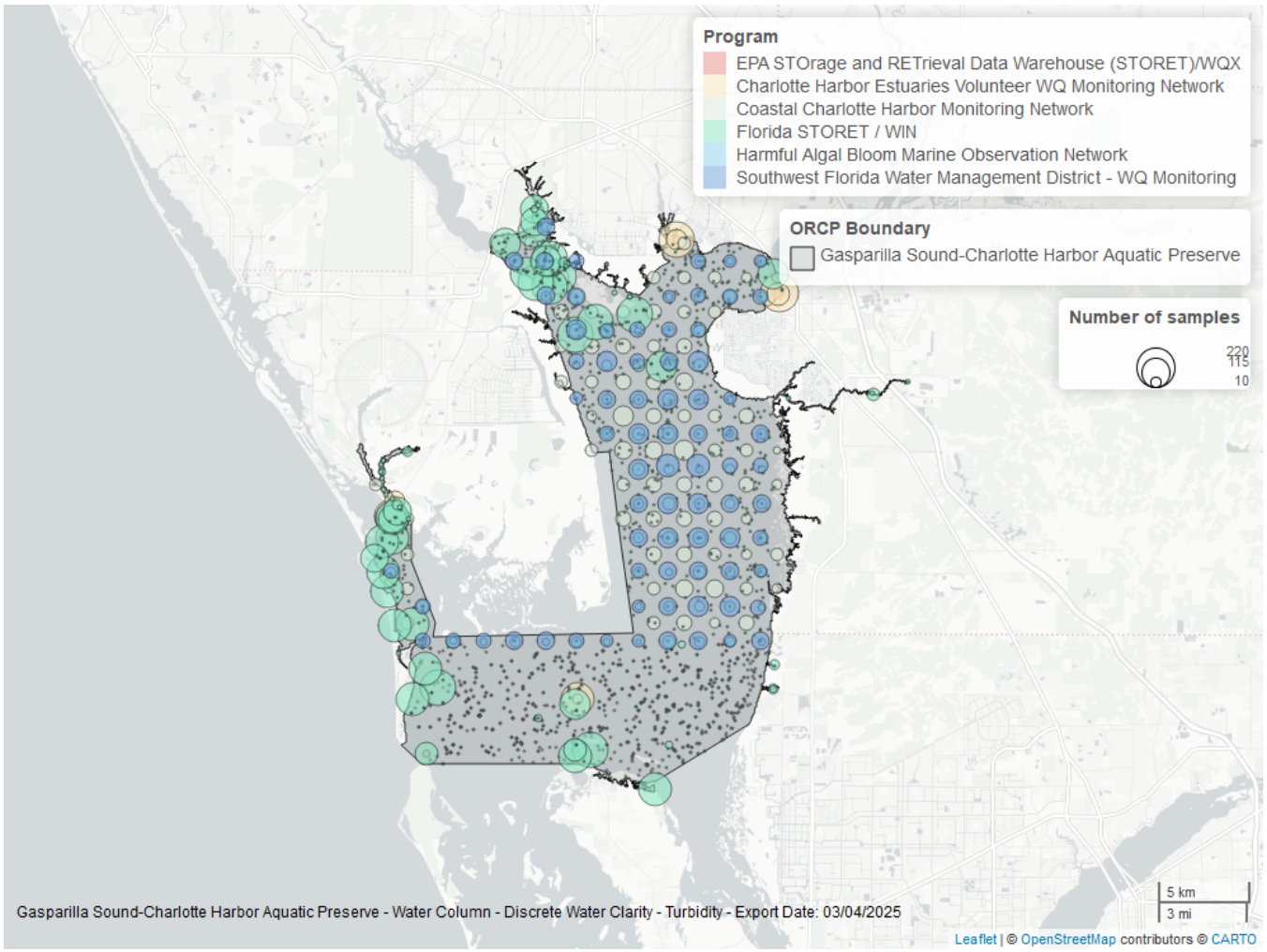

Figure 24: Map showing location of discrete water quality sampling locations within the boundaries of *Gasparilla Sound-Charlotte Harbor Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 29: Programs contributing data for Turbidity

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	8262	1995	2024
479	3386	2001	2016
513	2618	2001	2024
476	1108	1998	2024
103	159	2006	2022
95	6	2003	2003

Program names:

95 - Harmful Algal Bloom Marine Observation Network[7]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[1]
476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network[2]
479 - Southwest Florida Water Management District - Water Quality Monitoring[10]
513 - Coastal Charlotte Harbor Monitoring Network[3]
5002 - Florida STORET / WIN[4]

Water Temperature - Discrete

Seasonal Kendall-Tau Trend Analysis

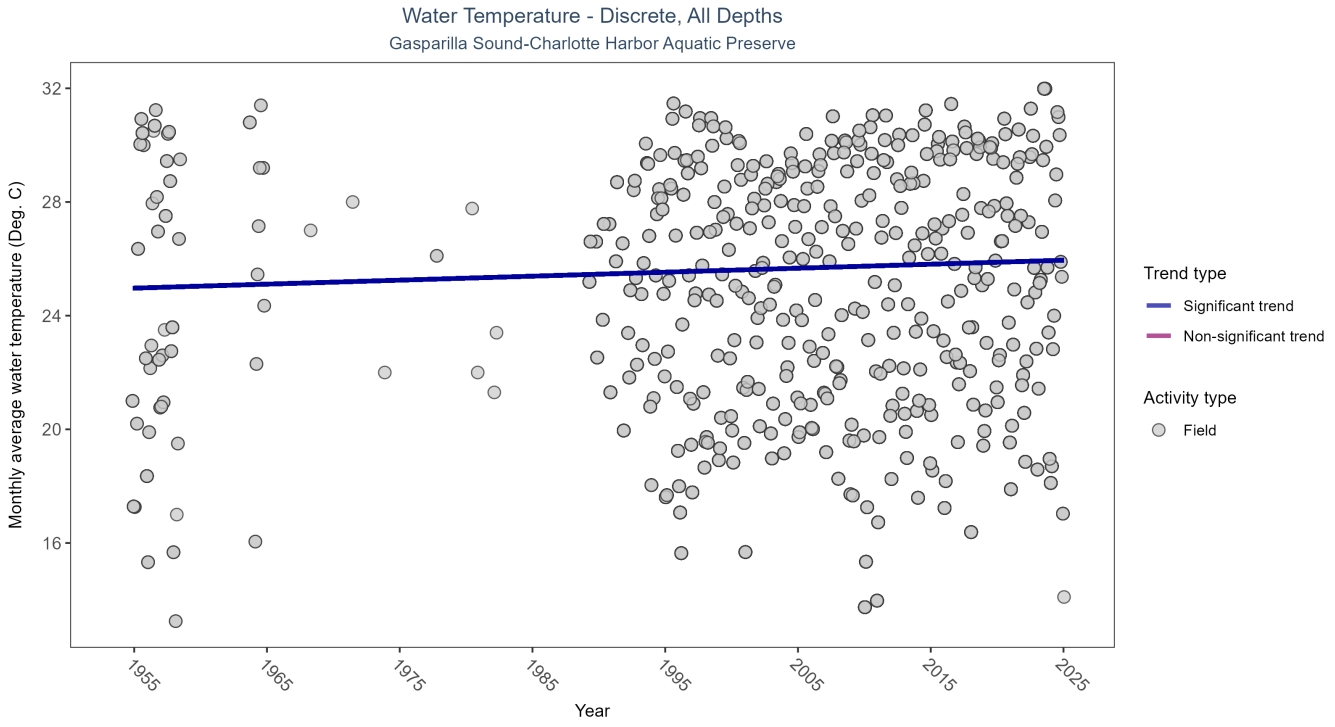

Figure 25: Scatter plot of monthly average water temperature over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only water temperature measurements taken in the field (circles) are included in 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	75636	50	1954 - 2025	26.06	0.125	24.9543	0.014	0.0001

Monthly average water temperature increased by 0.01°C per year.

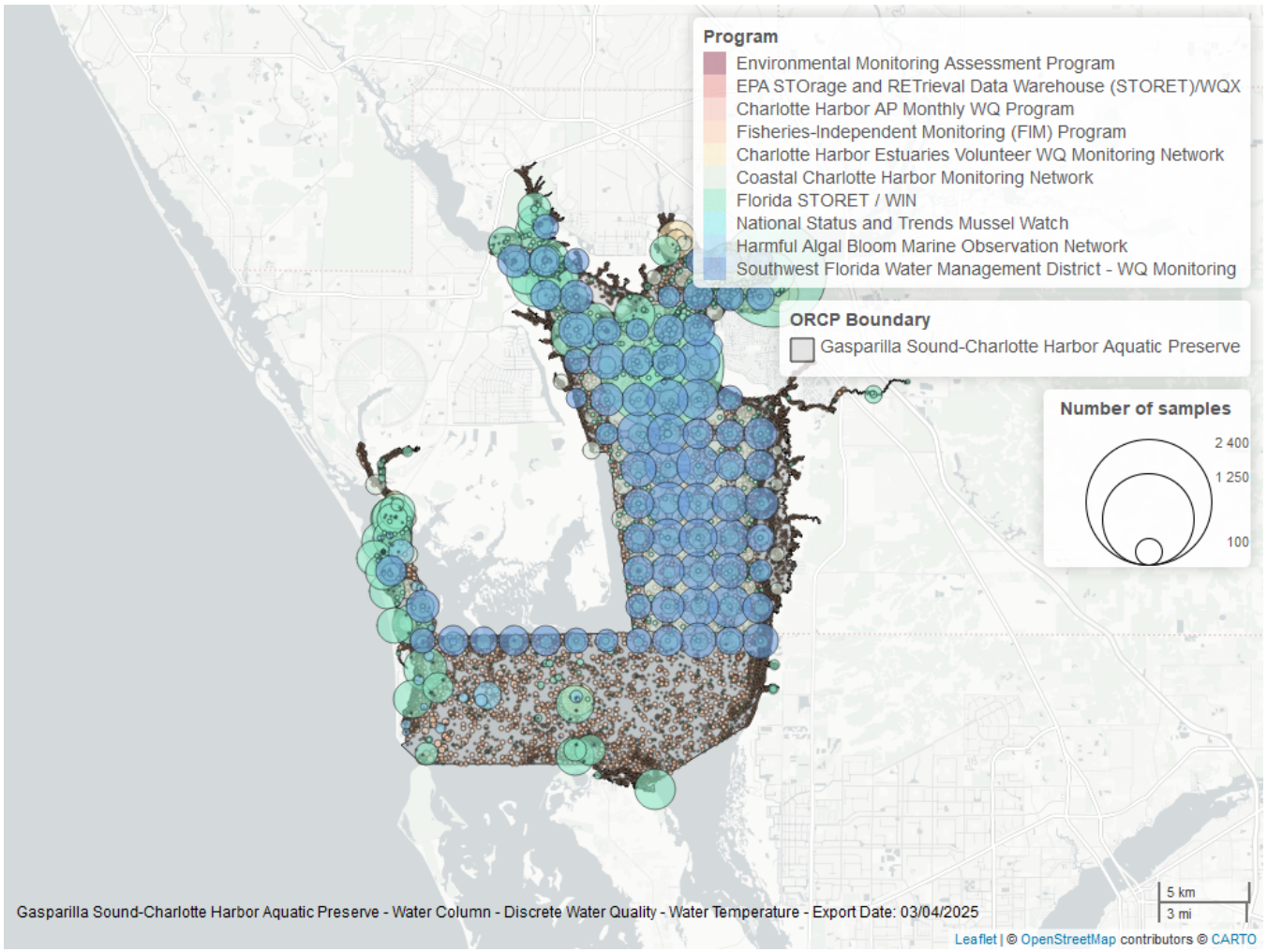

Figure 26: Map showing location of discrete water quality sampling locations within the boundaries of *Gasparilla Sound-Charlotte Harbor Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 31: Programs contributing data for Water Temperature

ProgramID	*N_Data*	*YearMin*	*YearMax*
69	36270	1989	2022
5002	20108	1993	2024
479	11918	2001	2016
513	5286	2001	2024
476	1137	1996	2024
95	722	1954	2018
103	150	2003	2022
115	27	2000	2004
5028	14	2024	2025
102	6	1992	1992

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program[12]
95 - Harmful Algal Bloom Marine Observation Network[7]

102 - National Status and Trends Mussel Watch[13]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[1]
115 - Environmental Monitoring Assessment Program[8]
476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network[2]
479 - Southwest Florida Water Management District - Water Quality Monitoring[10]
513 - Coastal Charlotte Harbor Monitoring Network[3]
5002 - Florida STORET / WIN[4]
5028 - Charlotte Harbor Aquatic Preserves Monthly Water Quality Program[5]

Water Quality - Continuous

The following files were used in the continuous analysis:

- *Combined_WQ_WC_NUT_cont_Dissolved_Oxygen_SW-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_cont_Dissolved_Oxygen_Saturation_SW-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_cont_pH_SW-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_cont_Salinity_SW-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_cont_Turbidity_SW-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_cont_Water_Temperature_SW-2025-Mar-06.txt*

Continuous monitoring locations in Gasparilla Sound-Charlotte Harbor Aquatic Preserve

Table 32: Station overview for Continuous parameters by Program

ProgramID	*ProgramLocationID*	*Years of Data*	*Use in Analysis*	*Parameters*
7	02293252	4	FALSE	Sal , TempW
7	02293254	4	FALSE	Sal , TempW
512	CHEW1	1	FALSE	DO , DOS , pH , Sal , Turb , TempW

Program names:

7 - National Water Information System[14]
512 - Charlotte Harbor Aquatic Preserves Continuous Water Quality Monitoring[15]

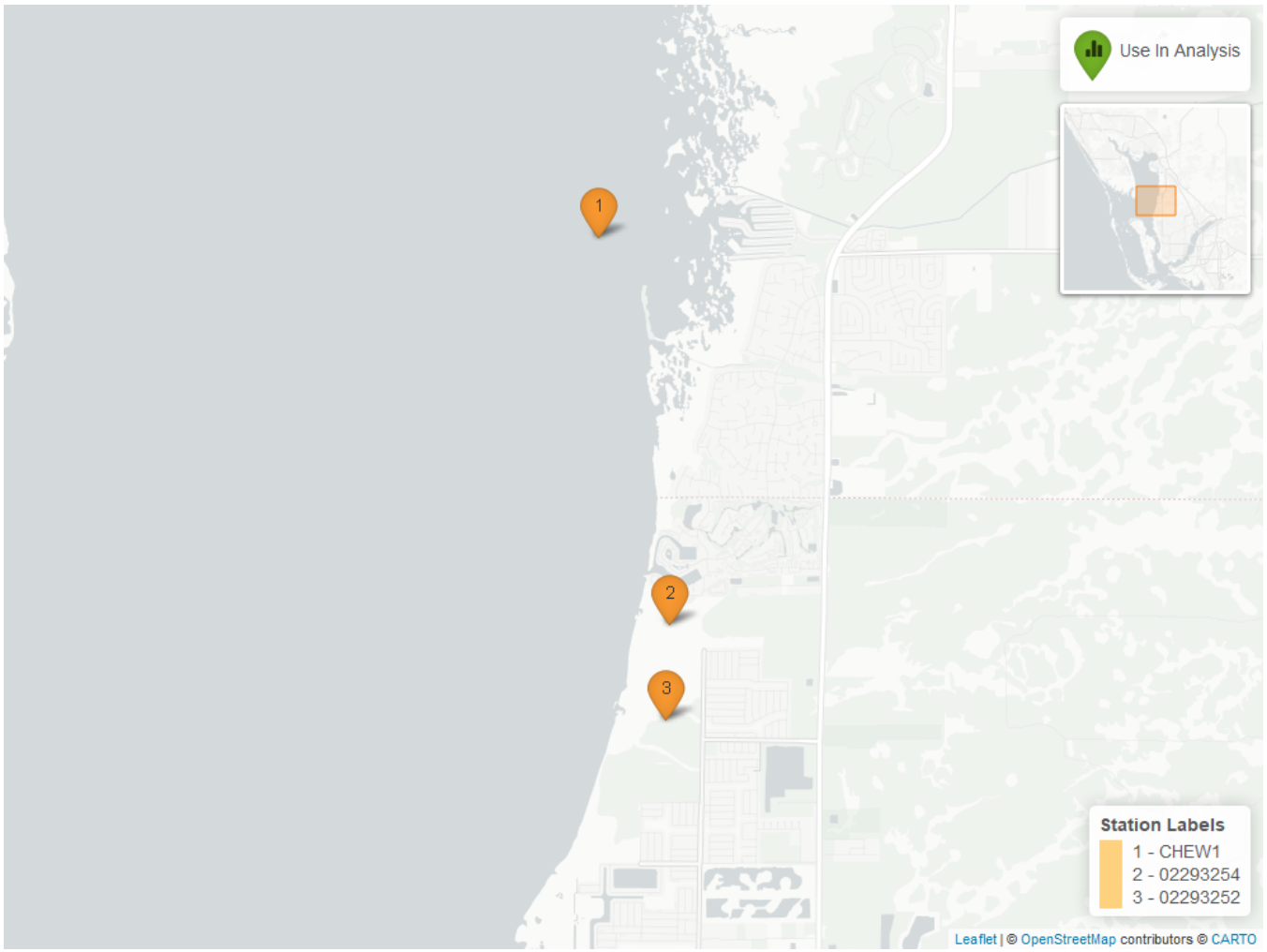

Figure 27: Map showing continuous water quality sampling locations within the boundaries of *Gasparilla Sound-Charlotte Harbor Aquatic Preserve*. Sites marked as *Use In Analysis* (green) are featured in this report.

Dissolved Oxygen - Continuous

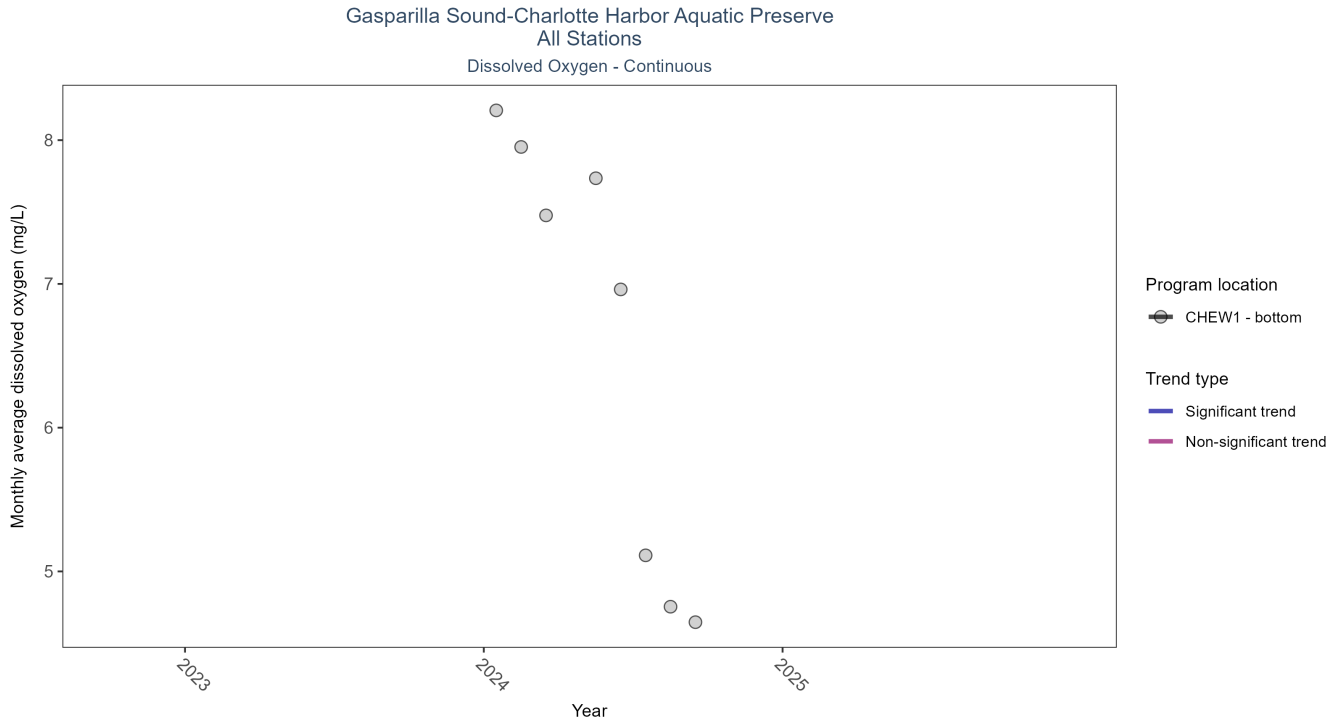

Figure 28: Scatter plot of monthly average dissolved oxygen over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

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
CHEW1	Insufficient data to calculate trend	18086	1	2024 - 2024	6.2	-	-	-	-

There was insufficient data to fit a model for one location.

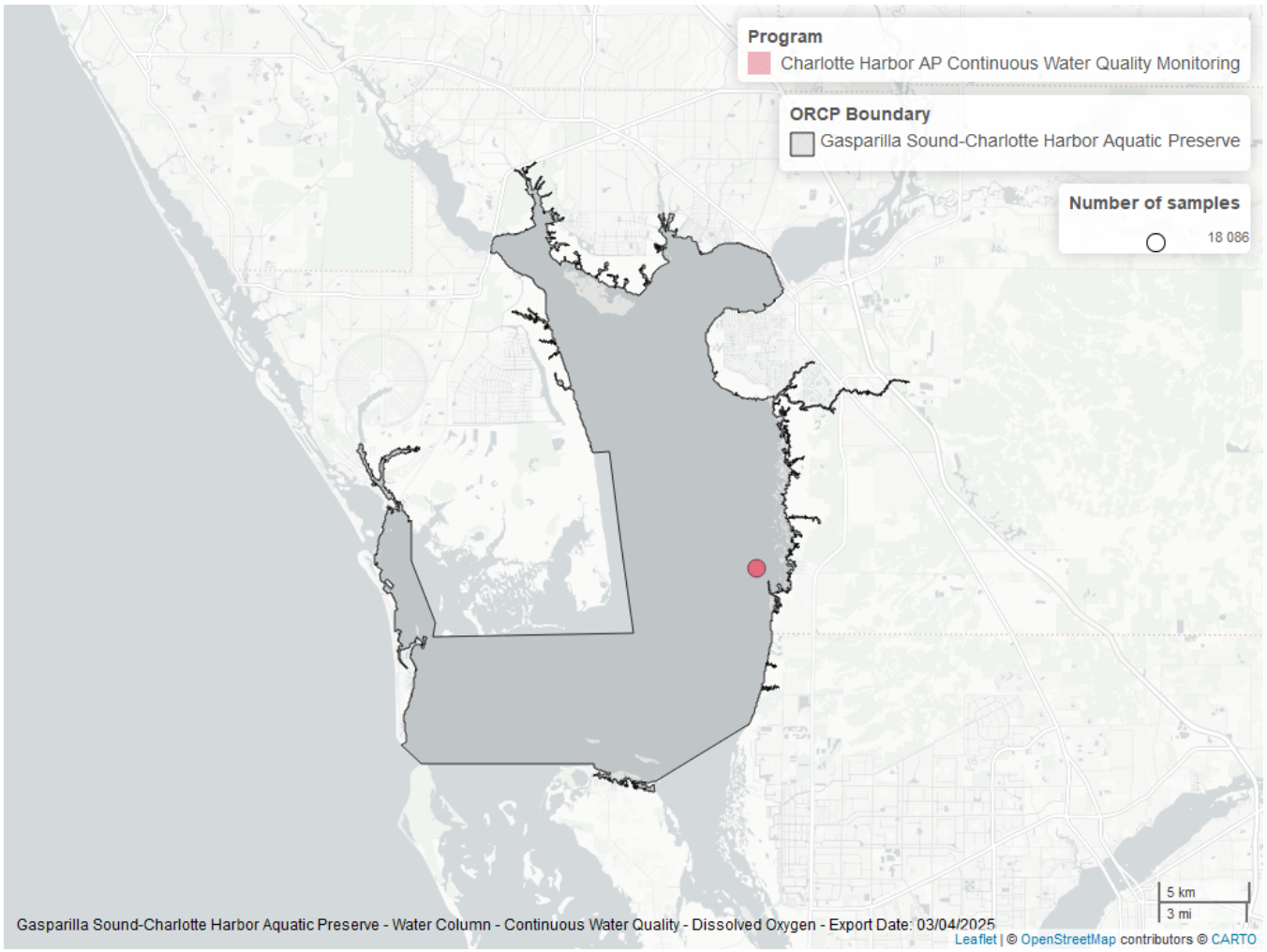

Figure 29: Map showing location of dissolved oxygen continuous water quality sampling locations within the boundaries of *Gasparilla Sound-Charlotte Harbor Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Dissolved Oxygen Saturation - Continuous

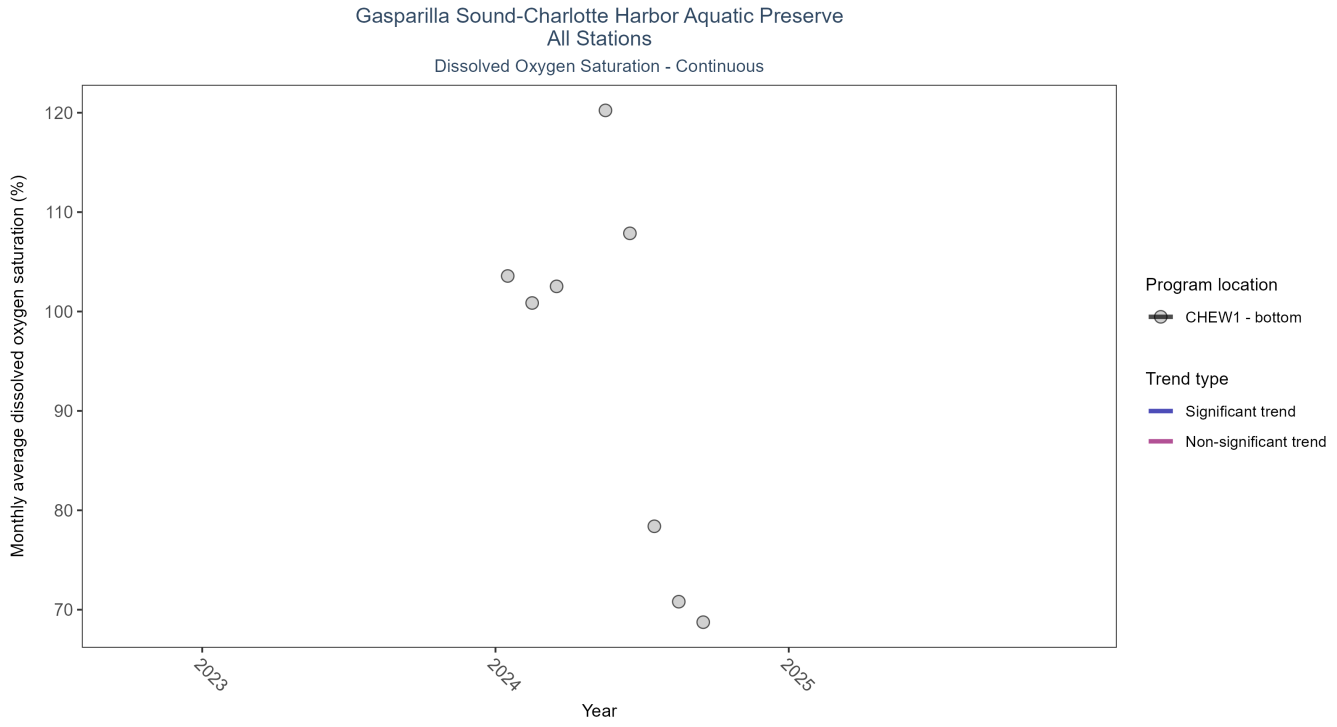

Figure 30: Scatter plot of monthly average dissolved oxygen saturation over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

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
CHEW1	Insufficient data to calculate trend	18086	1	2024 - 2024	89.6	-	-	-	-

There was insufficient data to fit a model for one location.

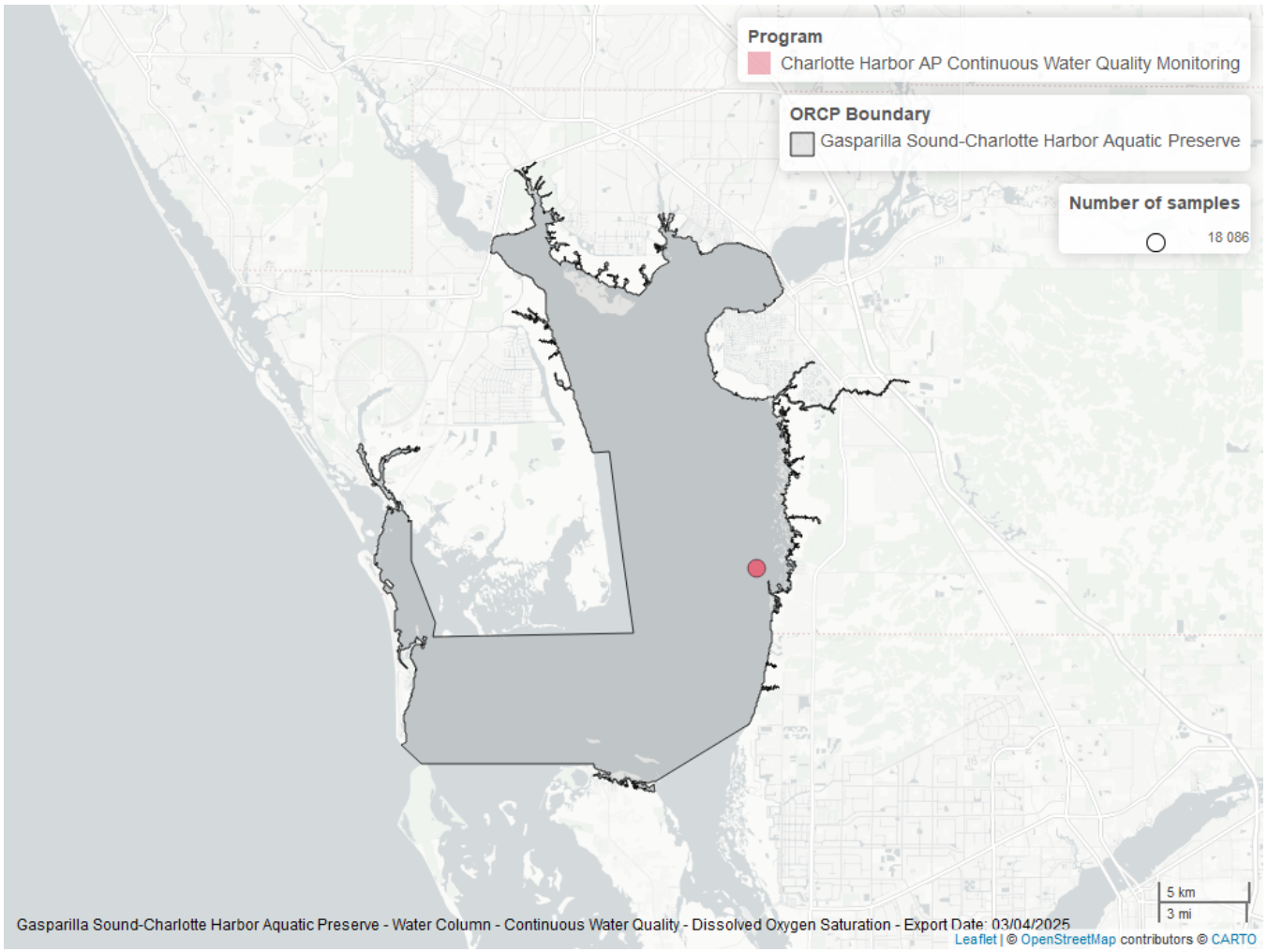

Figure 31: Map showing location of dissolved oxygen saturation continuous water quality sampling locations within the boundaries of *Gasparilla Sound-Charlotte Harbor Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

pH - Continuous

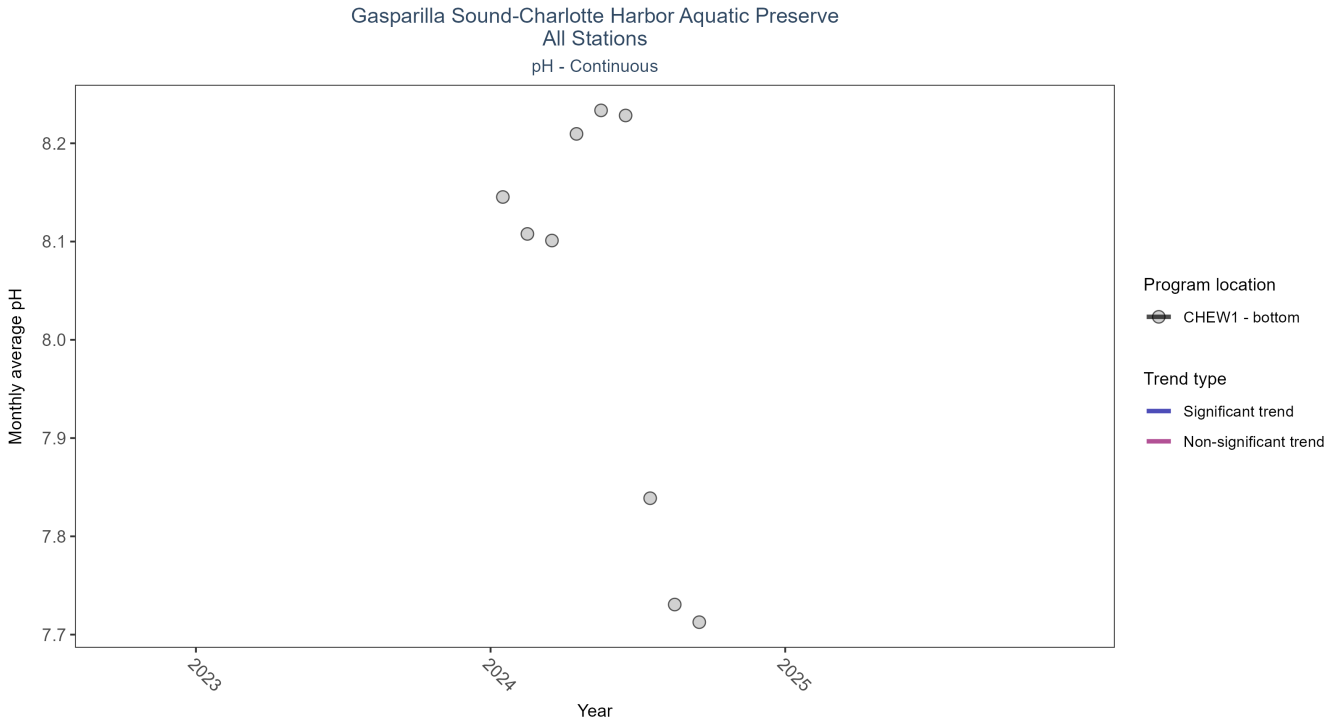

Figure 32: Scatter plot of monthly average pH over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

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
CHEW1	Insufficient data to calculate trend	20679	1	2024 - 2024	8	-	-	-	-

There was insufficient data to fit a model for one location.

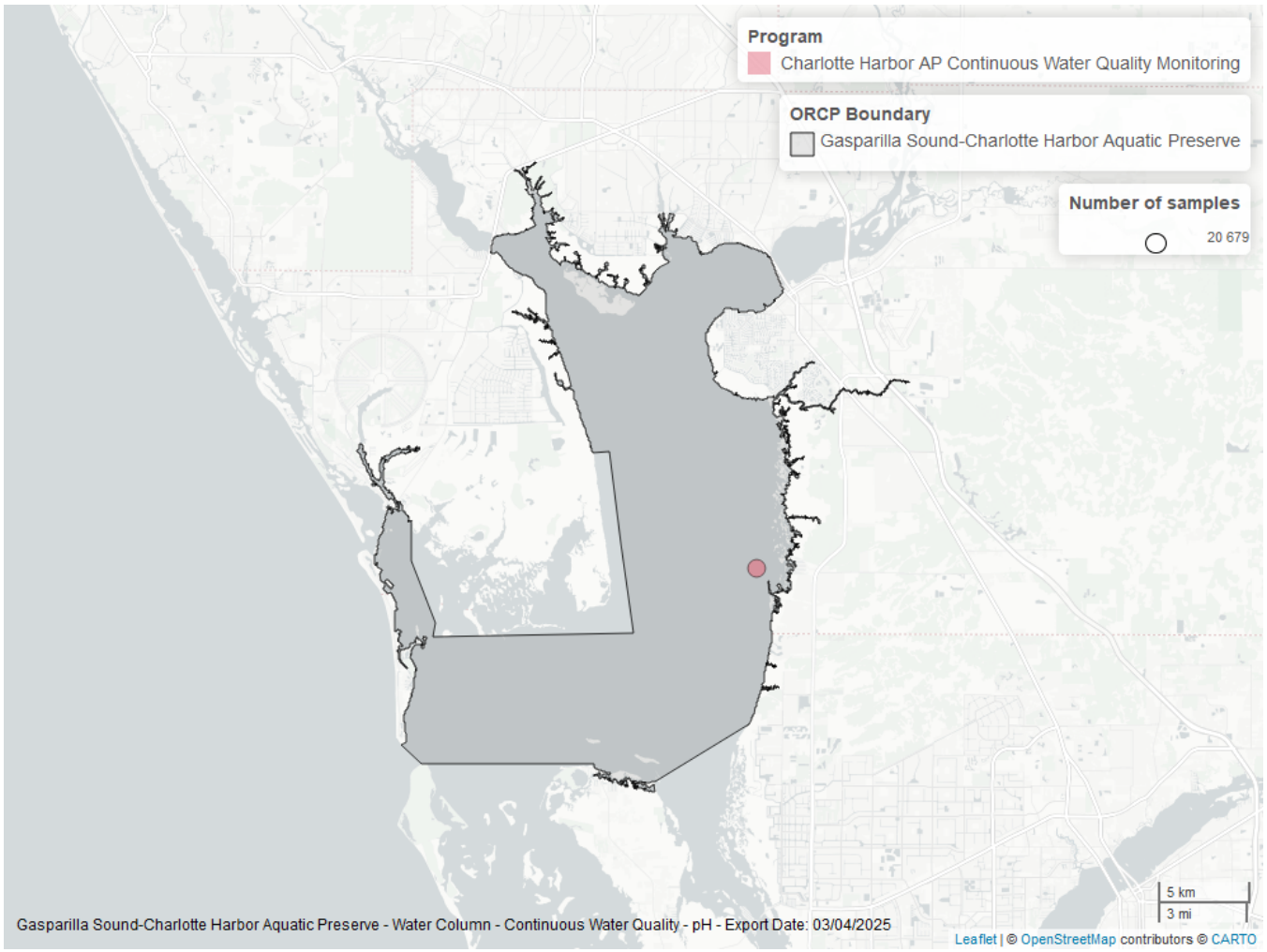

Figure 33: Map showing location of ph continuous water quality sampling locations within the boundaries of *Gasparilla Sound-Charlotte Harbor Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Salinity - Continuous

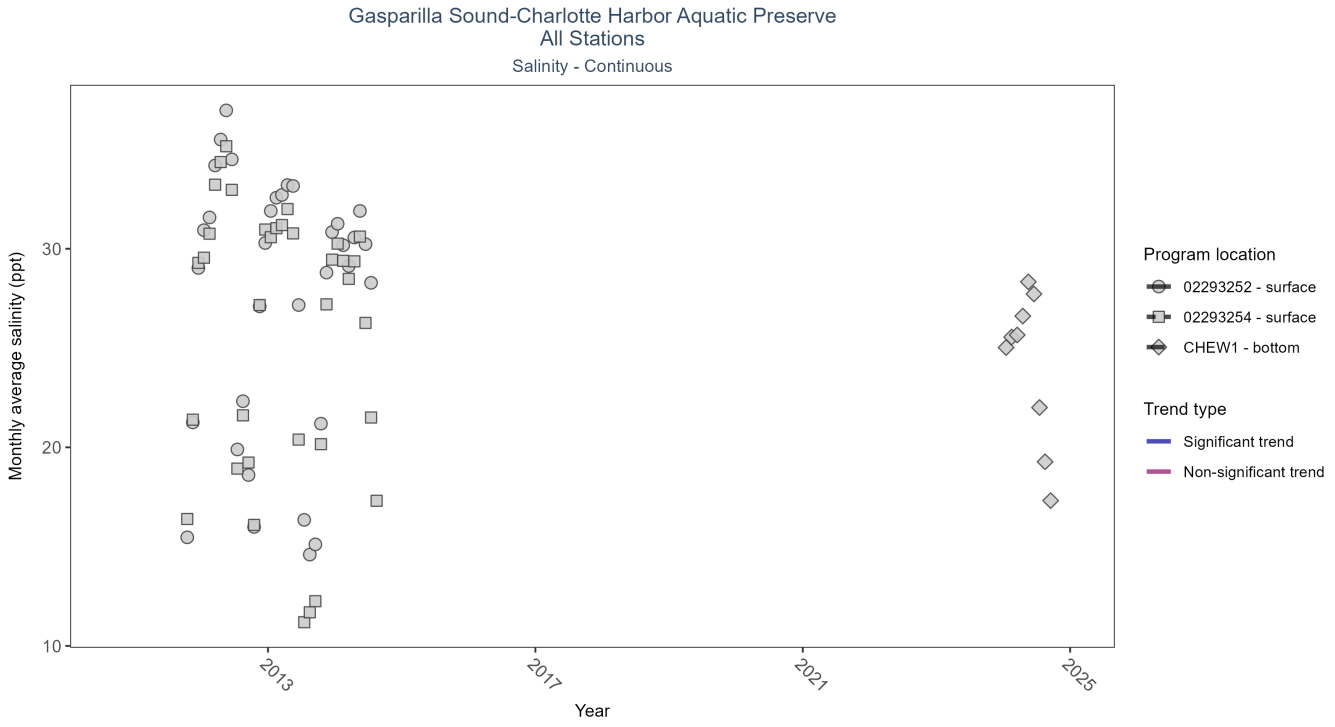

Figure 34: Scatter plot of monthly average salinity over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

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
02293252	Insufficient data to calculate trend	1002	4	2011 - 2014	30.0	-	-	-	-
02293254	Insufficient data to calculate trend	1030	4	2011 - 2014	29.0	-	-	-	-
CHEW1	Insufficient data to calculate trend	24038	1	2024 - 2024	25.4	-	-	-	-

There was insufficient data to fit a model for three locations.

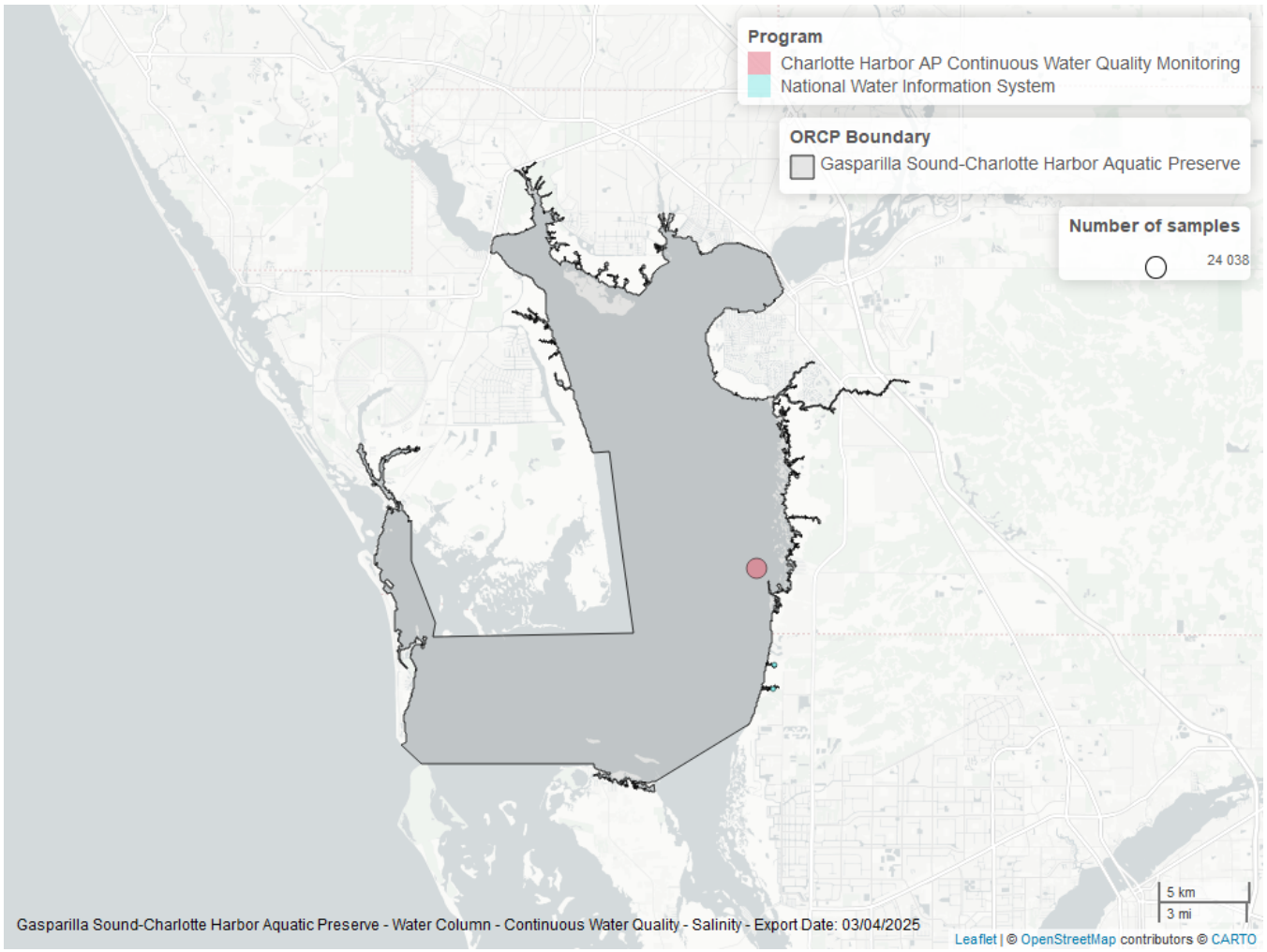

Figure 35: Map showing location of salinity continuous water quality sampling locations within the boundaries of *Gasparilla Sound-Charlotte Harbor Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Turbidity - Continuous

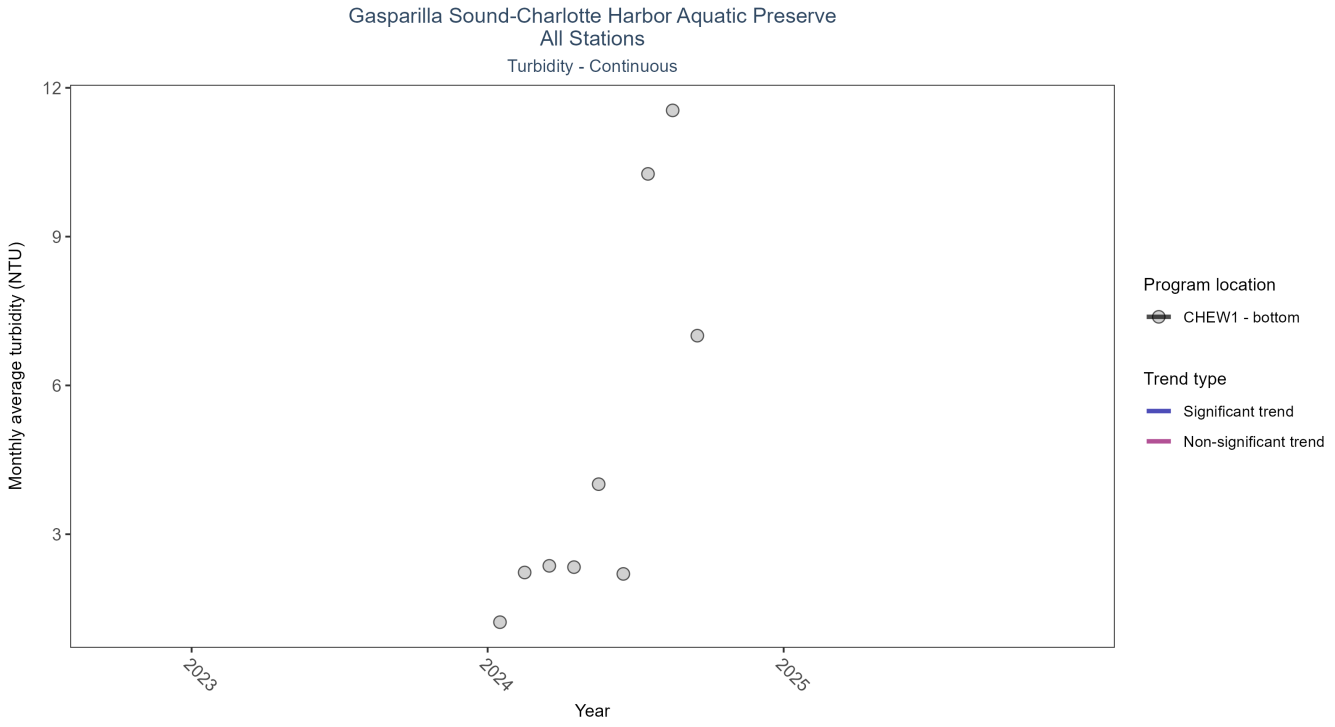

Figure 36: Scatter plot of monthly average turbidity over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

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
CHEW1	Insufficient data to calculate trend	18211	1	2024 - 2024	2	-	-	-	-

There was insufficient data to fit a model for one location.

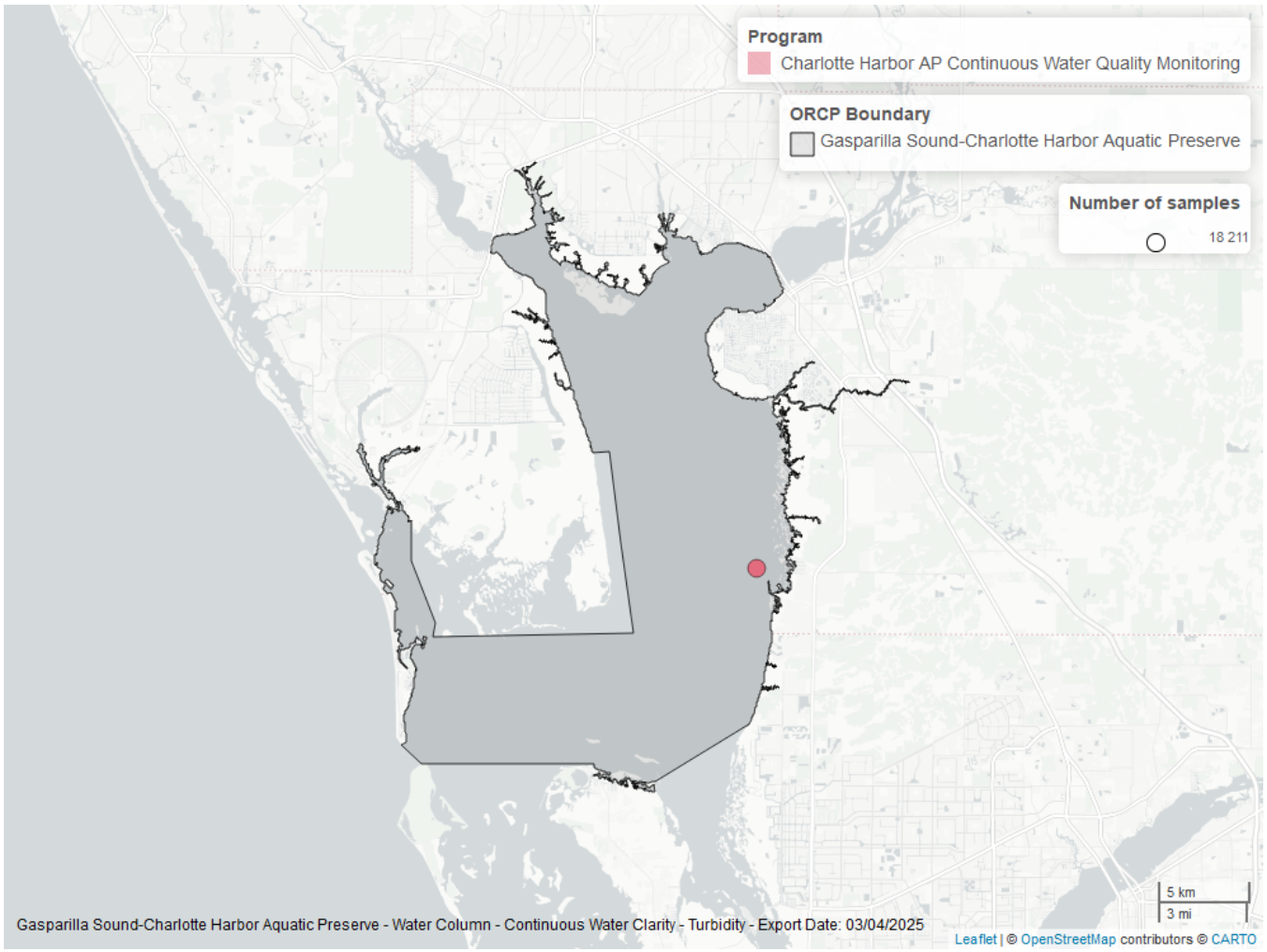

Figure 37: Map showing location of turbidity continuous water quality sampling locations within the boundaries of *Gasparilla Sound-Charlotte Harbor Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Water Temperature - Continuous

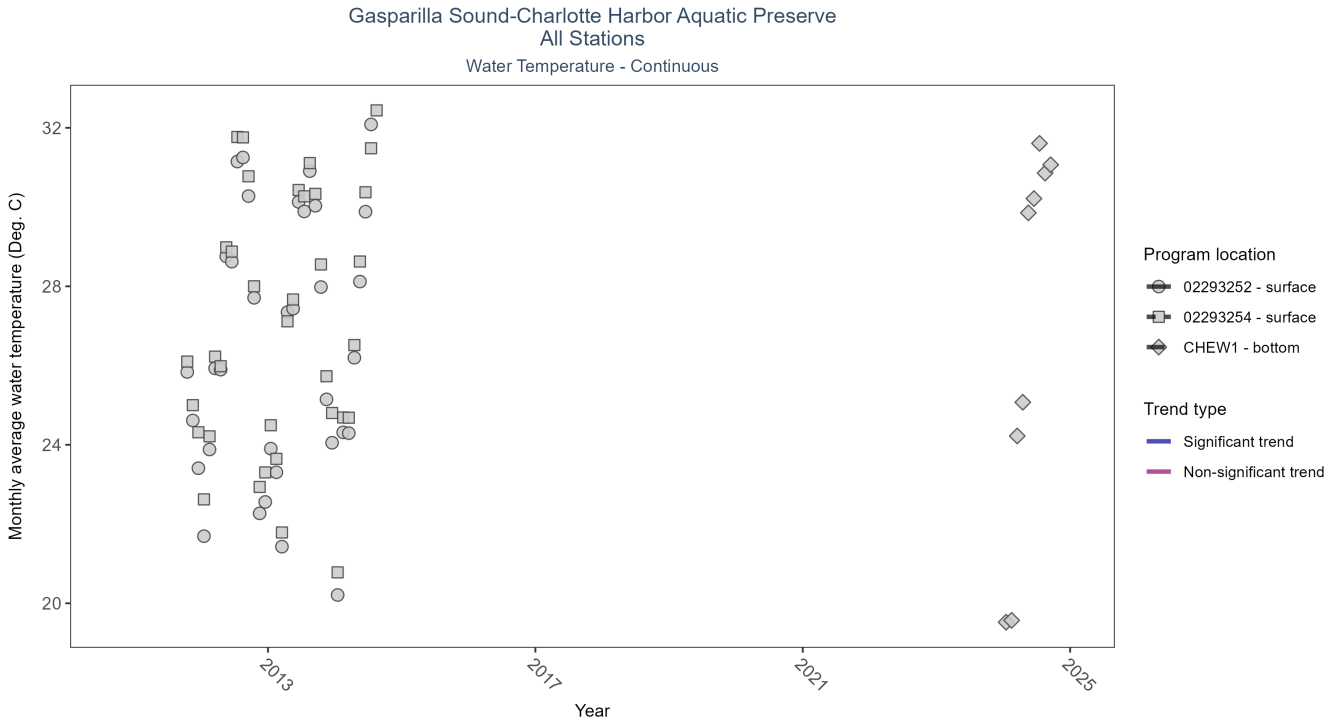

Figure 38: Scatter plot of monthly average water temperature over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

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
02293254	Insufficient data to calculate trend	1041	4	2011 - 2014	27.0	-	-	-	-
02293252	Insufficient data to calculate trend	1003	4	2011 - 2014	26.4	-	-	-	-
CHEW1	Insufficient data to calculate trend	24041	1	2024 - 2024	29.4	-	-	-	-

There was insufficient data to fit a model for three locations.

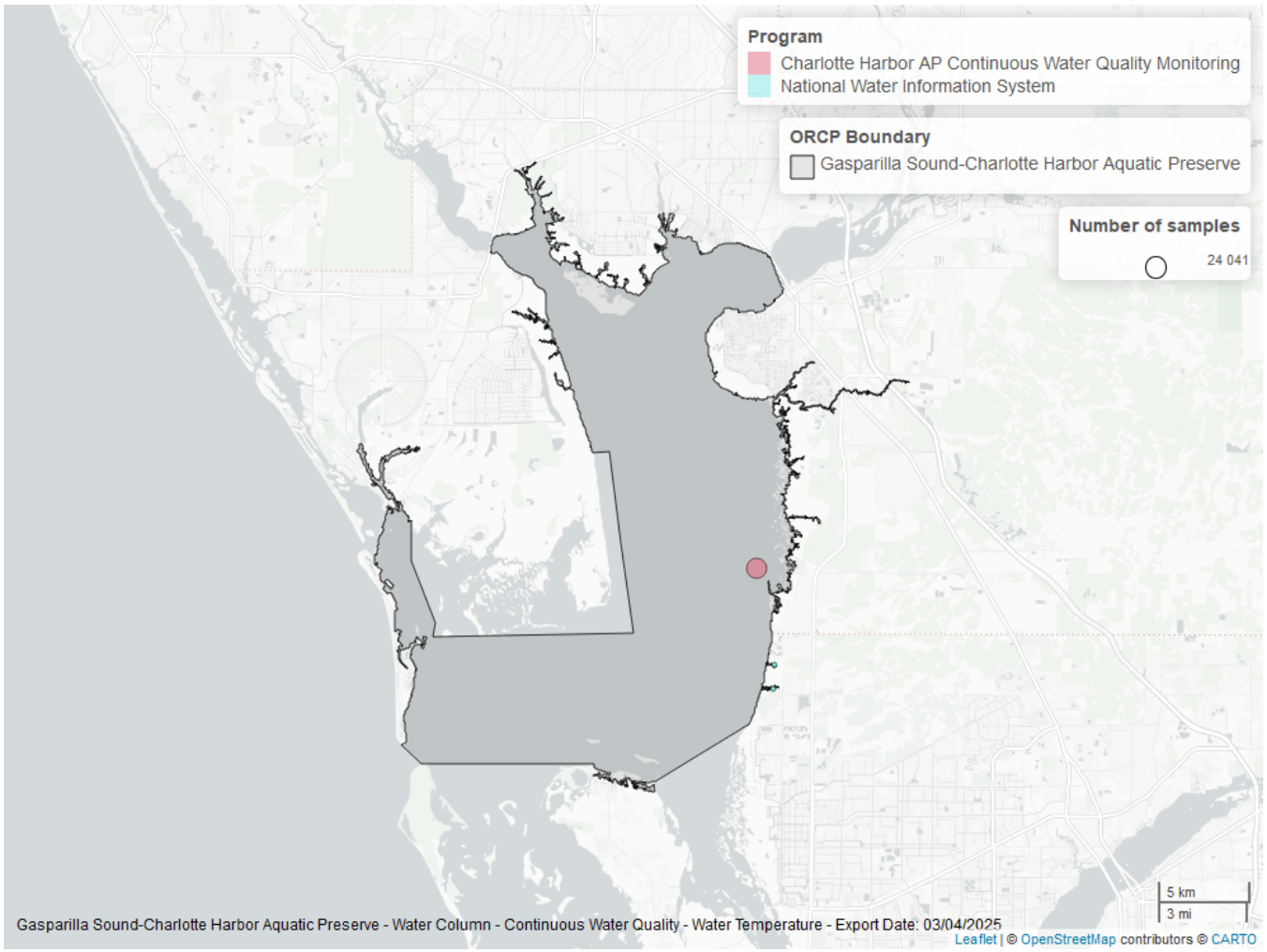

Figure 39: Map showing location of water temperature continuous water quality sampling locations within the boundaries of *Gasparilla Sound-Charlotte Harbor Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Submerged Aquatic Vegetation

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

Submerged aquatic vegetation (*SAV*) refers to plants and plant-like macroalgae species that live entirely underwater. The two primary categories of *SAV* inhabiting Florida estuaries are *benthic macroalgae* and *seagrasses*. They often grow together in dense beds or meadows that carpet the seafloor. *Macroalgae* include multicellular species of green, red and brown algae that often live attached to the substrate by a holdfast. They tend to grow quickly and can tolerate relatively high nutrient levels, making them a threat to seagrasses and other benthic habitats in areas with poor water quality. In contrast, *seagrasses* are grass-like, vascular, flowering plants that are attached to the seafloor by extensive root systems. *Seagrasses* occur throughout the coastal areas of Florida, including protected bays and lagoons as well as deeper offshore waters on the continental shelf. *Seagrasses* have taken advantage of the broad, shallow shelf and clear water to produce two of the most extensive seagrass beds anywhere in continental North America.

Parameters

Percent Cover measures the fraction of an area of seafloor that is covered by SAV, usually estimated by evaluating multiple small areas of seafloor. Percent cover is often estimated for total SAV, individual types of vegetation (seagrass, attached algae, drift algae) and individual species.

Frequency of Occurrence was calculated as the number of times a taxon was observed in a year divided by the number of sampling events, multiplied by 100. Analysis is conducted at the quadrat level and is inclusive of all quadrats (i.e., quadrats evaluated using Braun-Blanquet, modified Braun-Blanquet, and percent cover."

Species

Turtle grass (*Thalassia testudinum*) is the largest of the Florida seagrasses, with longer, thicker blades and deeper root structures than any of the other seagrasses. It is considered a climax seagrass species.

Shoal grass (*Halodule wrightii*) is an early colonizer of vegetated areas and usually grows in water too shallow for other species except *widgeon grass*. It can often tolerate larger salinity ranges than other seagrass species. *Shoal grass* is characterized by thin, flat blades, that are narrower than *turtle grass* blades.

Manatee grass (*Syringodium filiforme*) is easily recognizable because its leaves are thin and cylindrical instead of the flat, ribbon-like form shared by many other seagrass species. The leaves can grow up to half a meter in length. *Manatee grass* is usually found in mixed seagrass beds or small, dense monospecific patches.

Widgeon grass (*Ruppia maritima*) grows in both fresh and salt water and is widely distributed throughout Florida's estuaries in less saline areas, particularly in inlets along the east coast. This species resembles *shoal grass* in certain environments but can be identified by the pointed tips of its leaves.

Three species of *Halophila spp.* are found in Florida - **Star grass** (*Halophila engelmannii*), **Paddle grass** (*Halophila decipiens*), and **Johnson's seagrass** (*Halophila johnsonii*). These are smaller, more fragile seagrasses than other Florida species and are considered ephemeral. They grow along a single long rhizome, with short blades. These species are not well-studied, although surveys are underway to define their ecological roles.

Notes

Star grass, *Paddle grass*, and *Johnson's seagrass* will be grouped together and listed as **Halophila spp.** in the following managed areas. This is because several surveys did not specify to the species level:

- Banana River Aquatic Preserve
- Indian River-Malabar to Vero Beach Aquatic Preserve
- Indian River-Vero Beach to Ft. Pierce Aquatic Preserve
- Jensen Beach to Jupiter Inlet Aquatic Preserve
- Loxahatchee River-Lake Worth Creek Aquatic Preserve
- Mosquito Lagoon Aquatic Preserve

- Biscayne Bay Aquatic Preserve
- Florida Keys National Marine Sanctuary

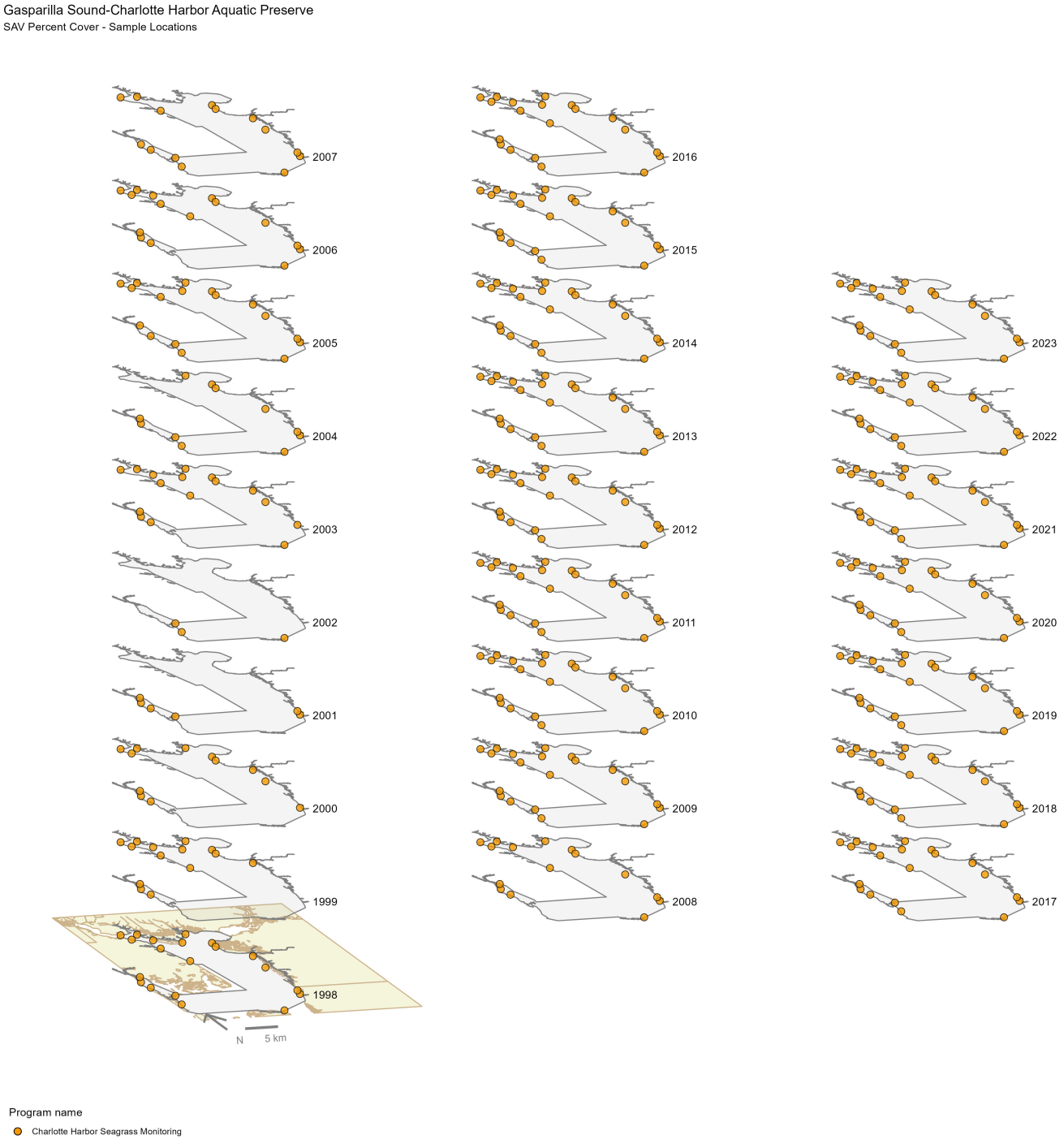

Figure 40: Maps showing the temporal scope of SAV sampling sites within the boundaries of *Gasparilla Sound-Charlotte Harbor Aquatic Preserve* by Program name.

Click here to view spatio-temporal plots on GitHub.

Sampling locations by Program:

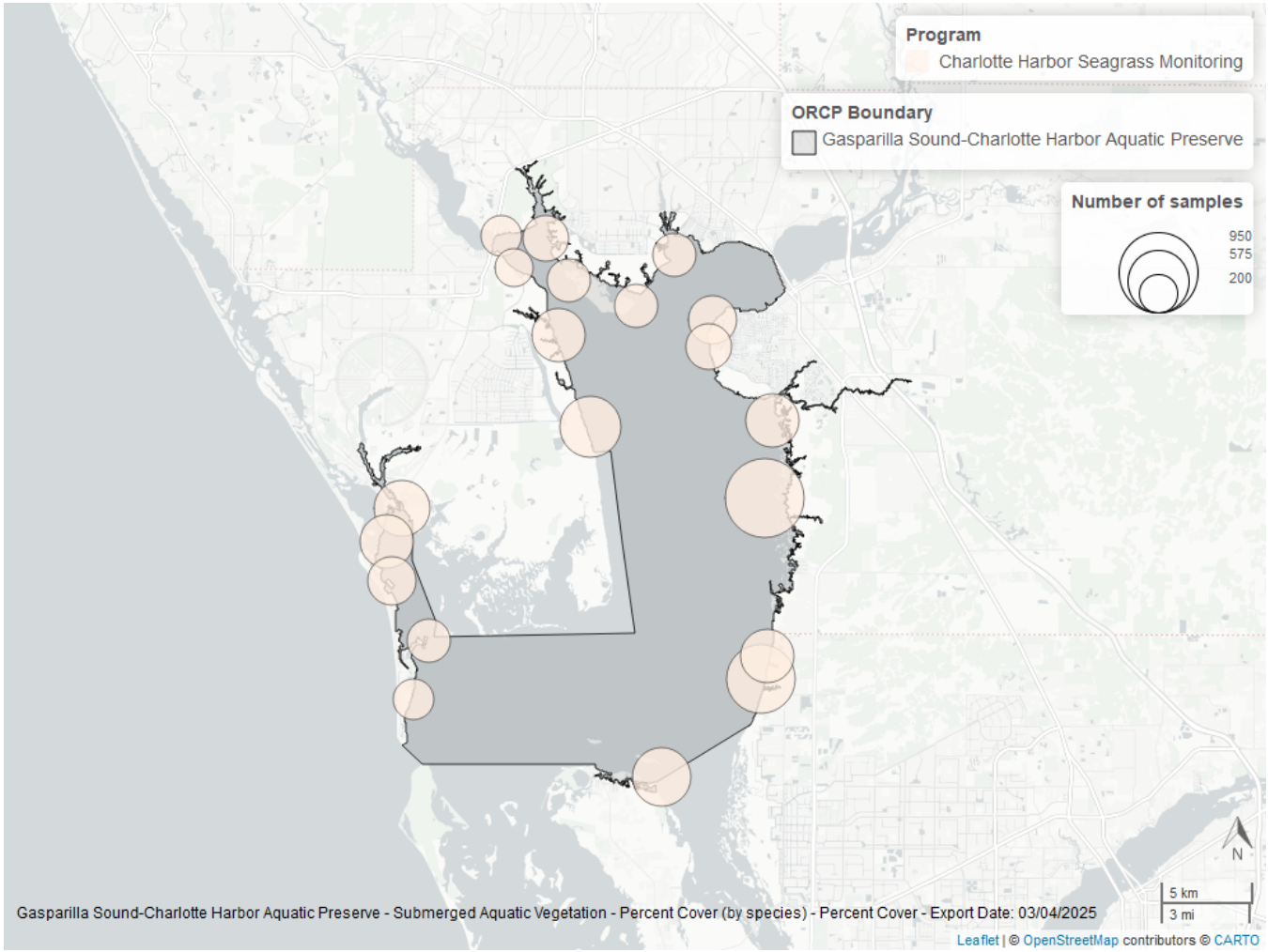

Figure 41: Map showing SAV sampling sites within the boundaries of *Gasparilla Sound-Charlotte Harbor Aquatic Preserve*. The point size reflects the number of samples at a given sampling site.

Table 39: Program Information for Submerged Aquatic Vegetation

ProgramID	*N-Data*	*YearMin*	*YearMax*	*method*	*Sample Locations*
570	8237	1998	2023	Braun Blanquet	20

Program names:

570 - Charlotte Harbor Seagrass Monitoring[16]

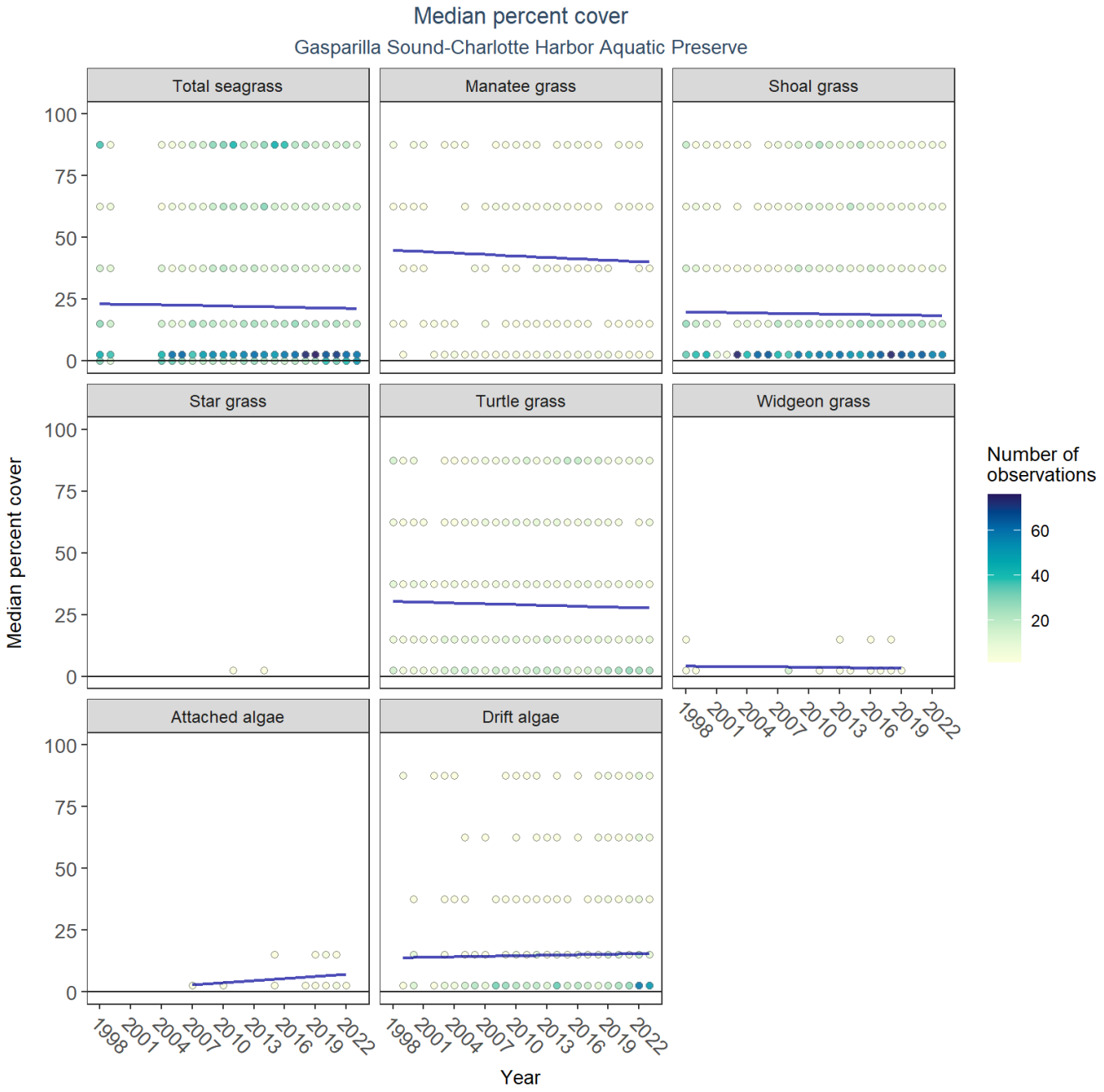

Figure 42: Scatter plots of median percent cover of submerged aquatic vegetation over time by group. Plots for time series that included five or more years of observations show the estimated trend as a blue line.

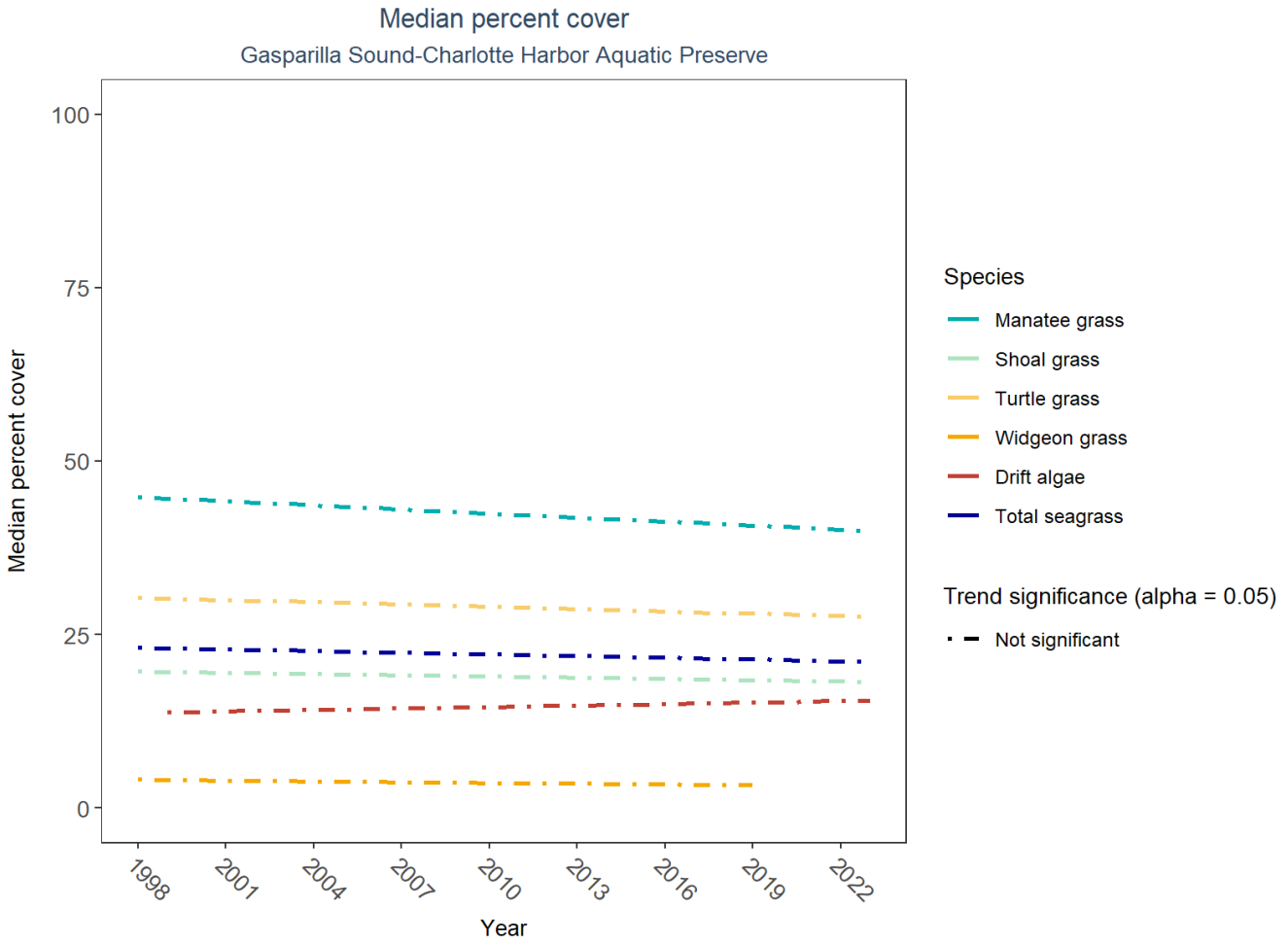

Figure 43: Trends in median percent cover for various seagrass species in Gasparilla Sound-Charlotte Harbor Aquatic Preserve - simplified

Table 40: Percent Cover Trend Analysis for Gasparilla Sound-Charlotte Harbor Aquatic Preserve

CommonName	*Trend Significance (0.05)*	*Period of Record*	*LME-Intercept*	*LME-Slope*	*p*
Attached algae	No significant trend	2007 - 2022	-0.7444646	0.2838889	0.3167561
Drift algae	No significant trend	1999 - 2023	13.4261991	0.0716180	0.7736890
Shoal grass	No significant trend	1998 - 2023	19.9204309	-0.0582910	0.4404081
Star grass	Insufficient data to calculate trend	-	-	-	-
No grass in quadrat	Model did not fit the available data	1998 - 2023	-	-	-
Widgeon grass	No significant trend	1998 - 2019	4.2619668	-0.0392844	0.7955335
Manatee grass	No significant trend	1998 - 2023	45.5874285	-0.1951331	0.7377885
Turtle grass	No significant trend	1998 - 2023	30.7773452	-0.1100611	0.5650684
Total seagrass	No significant trend	1998 - 2023	23.4553860	-0.0812940	0.2854250

Total seagrass, manatee grass, shoal grass, turtle grass, widgeon grass, attached algae, and drift algae showed no detectable change in percent cover. Trends in percent cover could not be evaluated for star grass due to insufficient data.

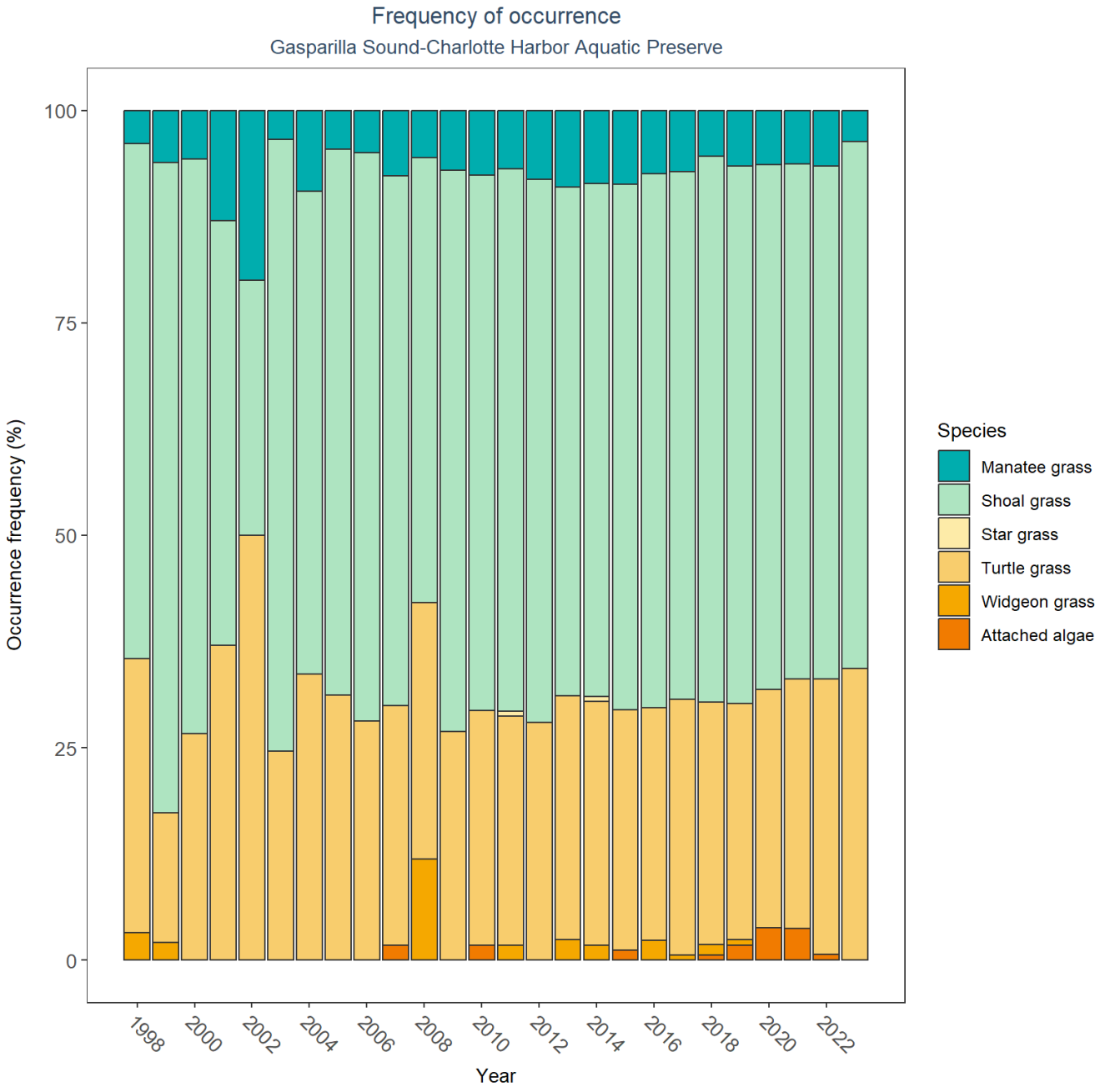

Figure 44: Frequency of occurrence for various seagrass species in Gasparilla Sound-Charlotte Harbor Aquatic Preserve

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