Boca Ciega Bay Aquatic Preserve

SEACAR Habitat Analyses

Last compiled on 08 October, 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	m^-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-Sep-04.txt*
- *Combined_WQ_WC_NUT_Chlorophyll_a_uncorrected_for_pheophytin-2025-Sep-04.txt*
- *Combined_WQ_WC_NUT_Colored_dissolved_organic_matter_CDOM-2025-Sep-04.txt*
- *Combined_WQ_WC_NUT_Dissolved_Oxygen-2025-Sep-04.txt*
- *Combined_WQ_WC_NUT_Dissolved_Oxygen_Saturation-2025-Sep-04.txt*
- *Combined_WQ_WC_NUT_pH-2025-Sep-04.txt*
- *Combined_WQ_WC_NUT_Salinity-2025-Sep-04.txt*
- *Combined_WQ_WC_NUT_Secchi_Depth-2025-Sep-04.txt*
- *Combined_WQ_WC_NUT_Total_Nitrogen-2025-Sep-04.txt*
- *Combined_WQ_WC_NUT_Total_Phosphorus-2025-Sep-04.txt*
- *Combined_WQ_WC_NUT_Total_Suspended_Solids_TSS-2025-Sep-04.txt*
- *Combined_WQ_WC_NUT_Turbidity-2025-Sep-04.txt*
- *Combined_WQ_WC_NUT_Water_Temperature-2025-Sep-04.txt*

Chlorophyll a, Corrected for Pheophytin - Discrete

Seasonal Kendall-Tau Trend Analysis

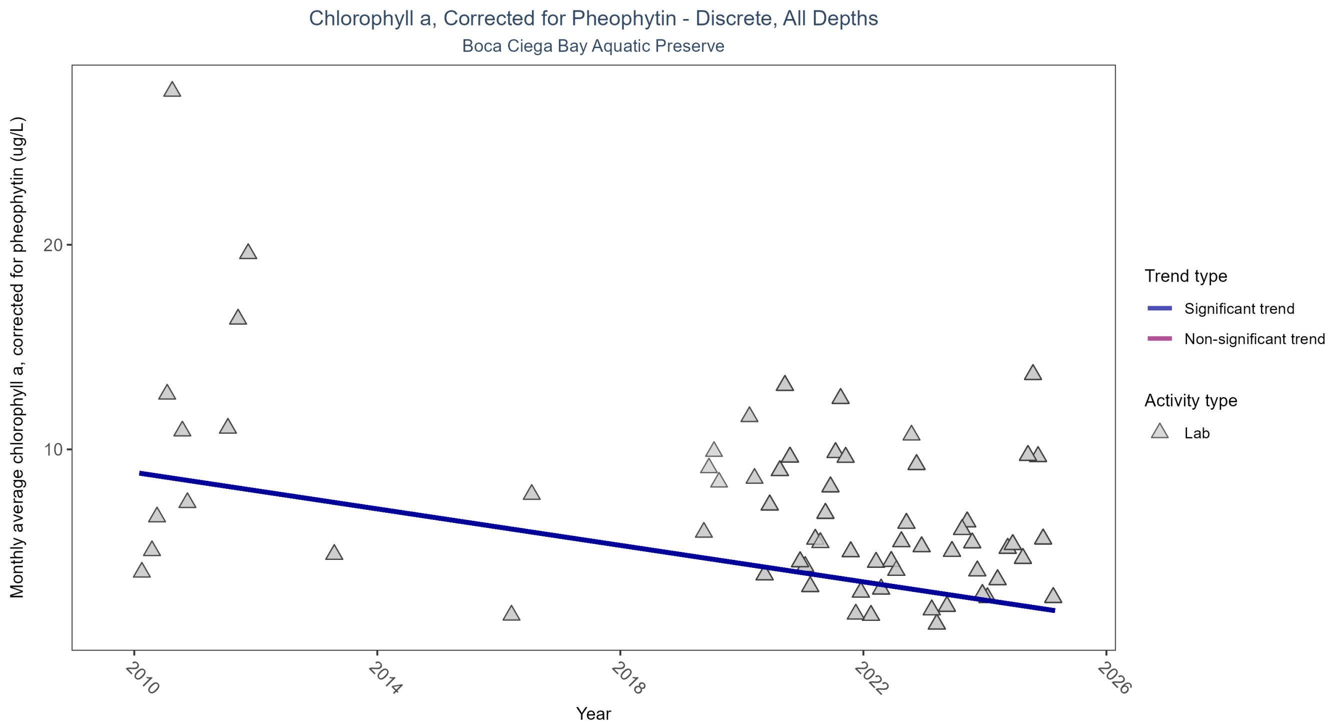

Figure 1: Scatter plot of monthly average levels of chlorophyll a, corrected for pheophytin, over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed chlorophyll a (triangles) 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	711	11	2010 - 2025	4.6	-0.3434	8.8752	-0.4458	0.0021

Monthly average chlorophyll a, corrected for pheophytin, decreased by 0.45 µg/L per year, indicating an increase in water clarity.

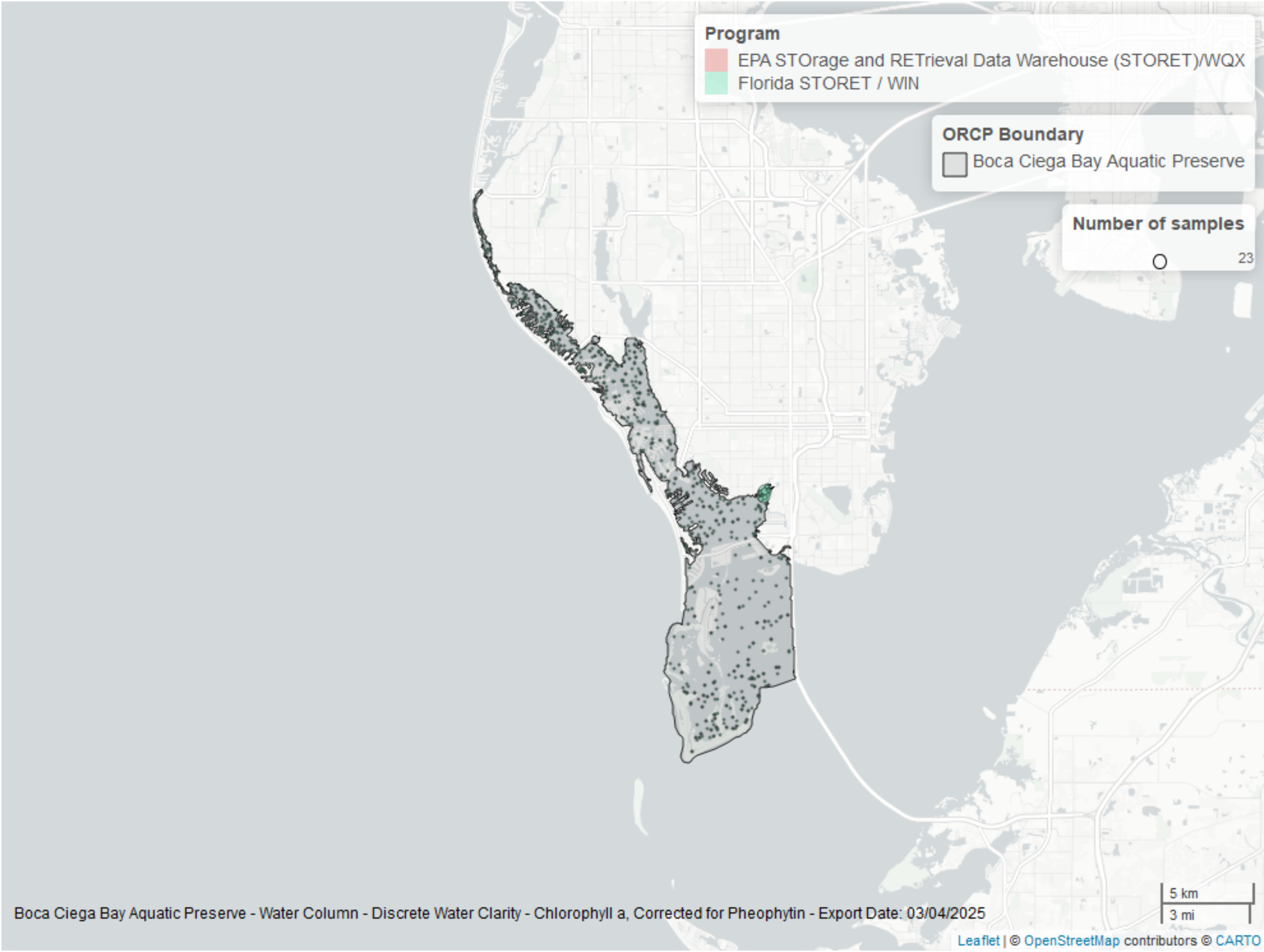

Figure 2: Map showing location of discrete water quality sampling locations within the boundaries of *Boca Ciega Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

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

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	726	2010	2025

Program names:

5002 - Florida STORET / WIN[1]

Chlorophyll a, Uncorrected for Pheophytin - Discrete

Seasonal Kendall-Tau Trend Analysis

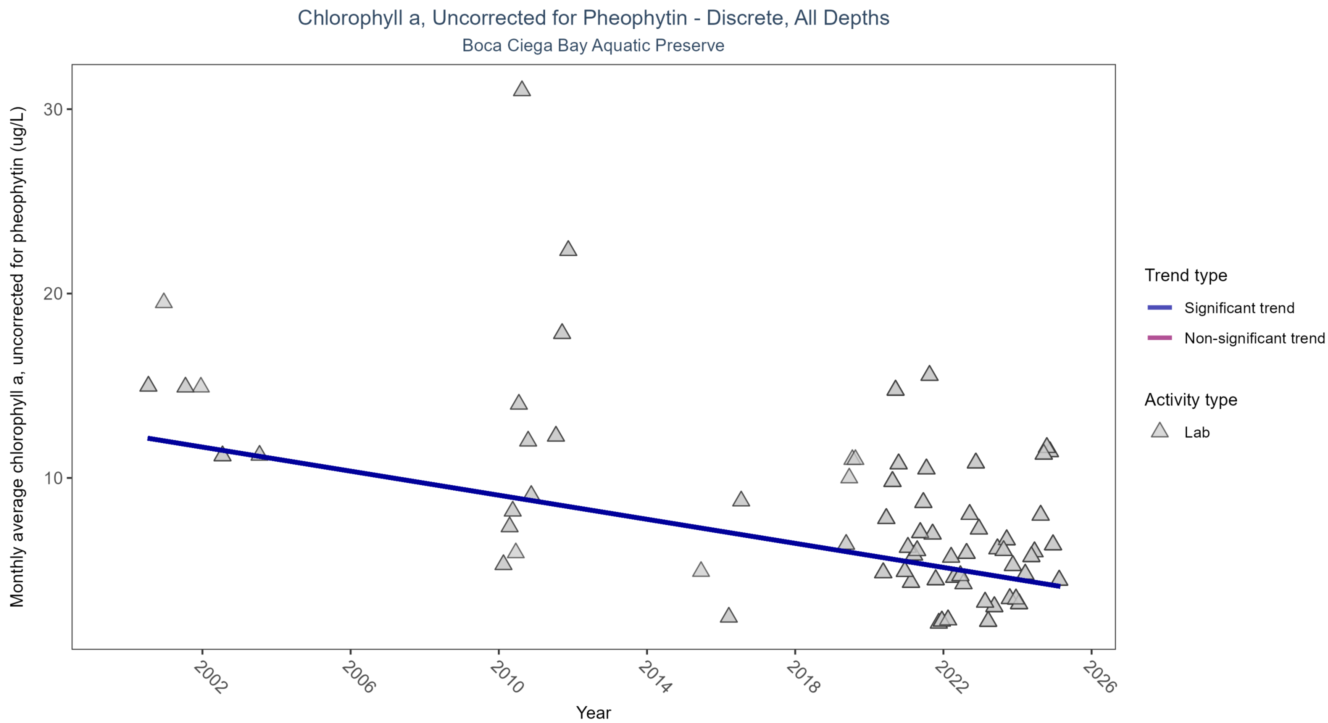

Figure 3: Scatter plot of monthly average levels of chlorophyll a, uncorrected for pheophytin, over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed chlorophyll a (triangles) 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	681	15	2000 - 2025	5.4	-0.4047	12.3253	-0.3263	0.0002

Monthly average chlorophyll a, uncorrected for pheophytin, decreased by 0.33 µg/L per year, indicating an increase in water clarity.

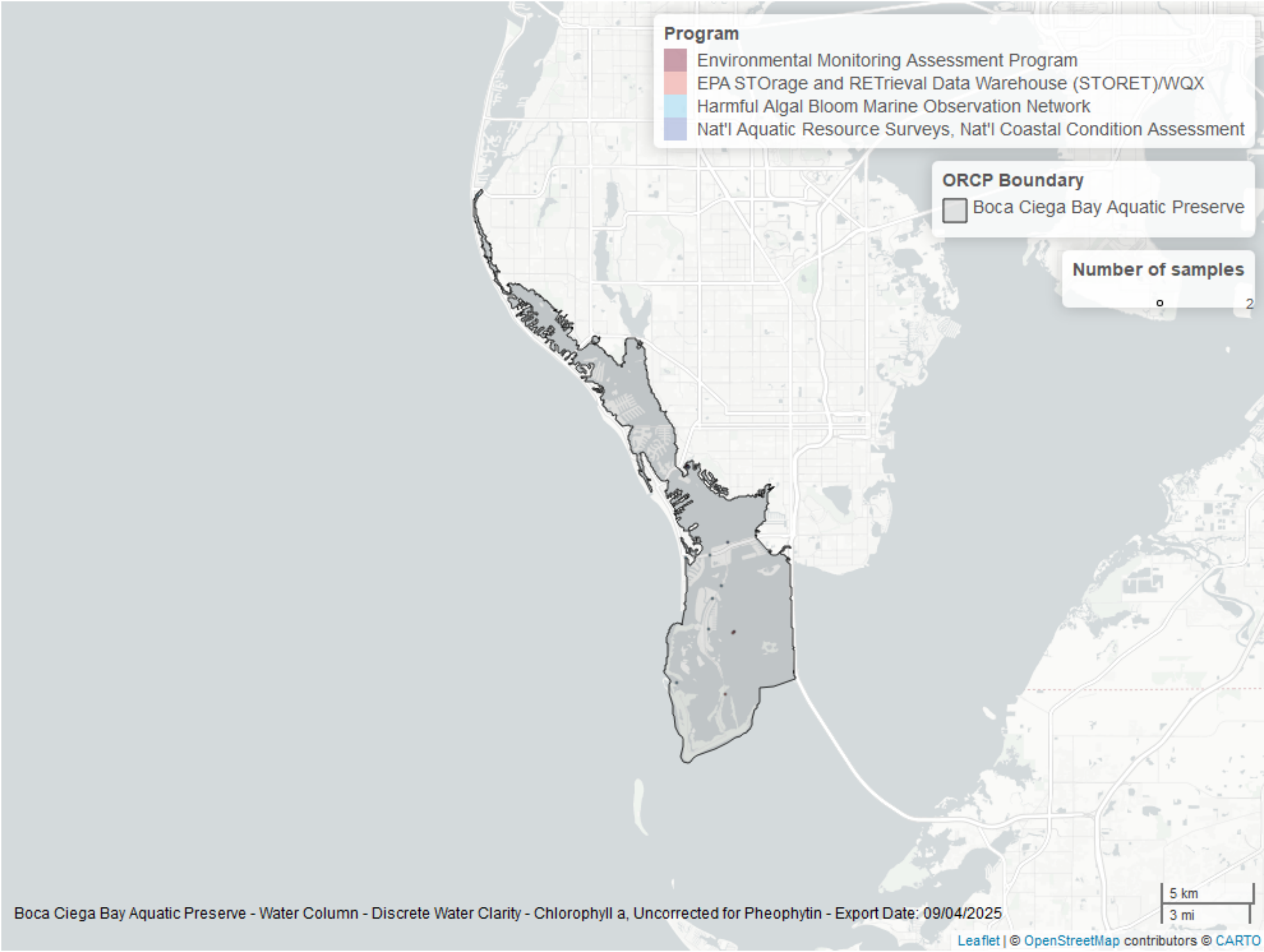

Figure 4: Map showing location of discrete water quality sampling locations within the boundaries of *Boca Ciega Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

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

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	668	2010	2025
95	8	2004	2018
103	7	2000	2015
115	5	2000	2003
118	3	2000	2010

Program names:

95 - Harmful Algal Bloom Marine Observation Network[2]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[3]
115 - Environmental Monitoring Assessment Program[4]
118 - National Aquatic Resource Surveys, National Coastal Condition Assessment[5]
5002 - Florida STORET / WIN[1]

Dissolved Oxygen - Discrete

Seasonal Kendall-Tau Trend Analysis

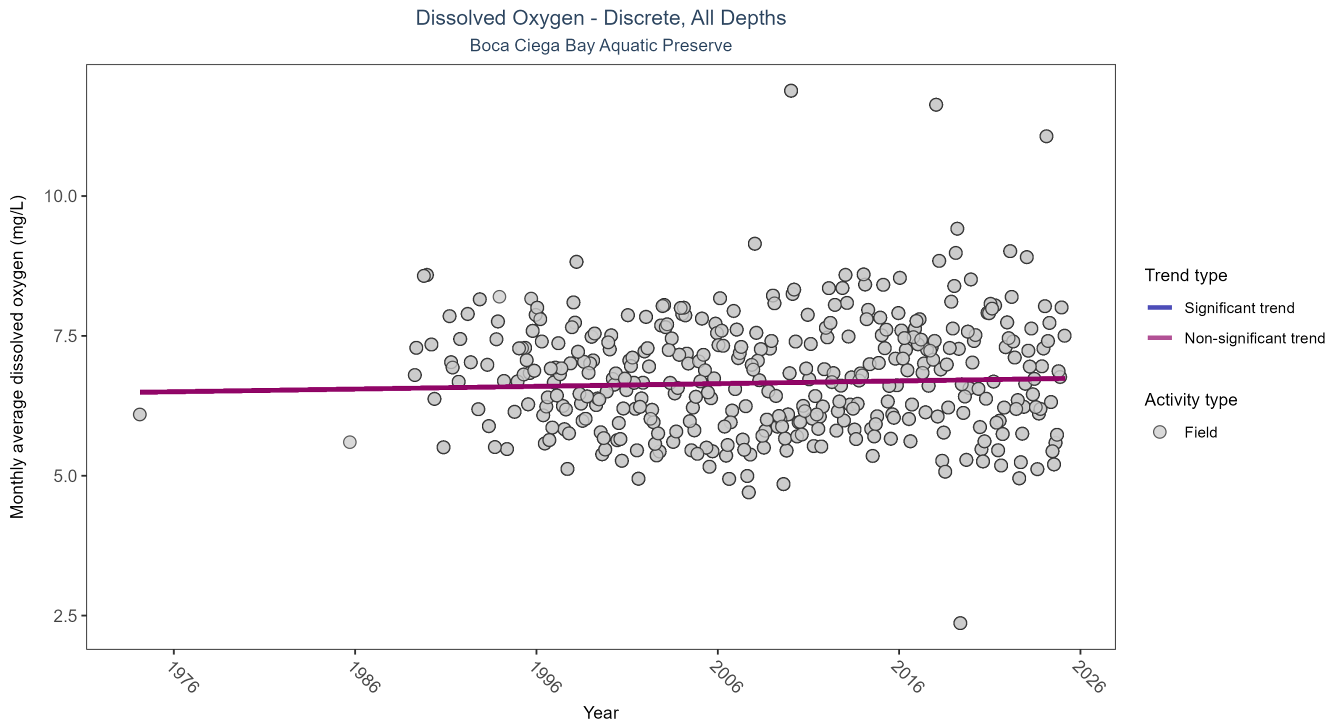

Figure 5: Scatter plot of monthly average dissolved oxygen over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only dissolved oxygen values measured in the field (circles) are included in the plot.

Table 10: 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	No significant trend	30556	39	1974 - 2025	6.44	0.0503	6.4914	0.0048	0.179

Dissolved oxygen showed no detectable trend between 1974 and 2025.

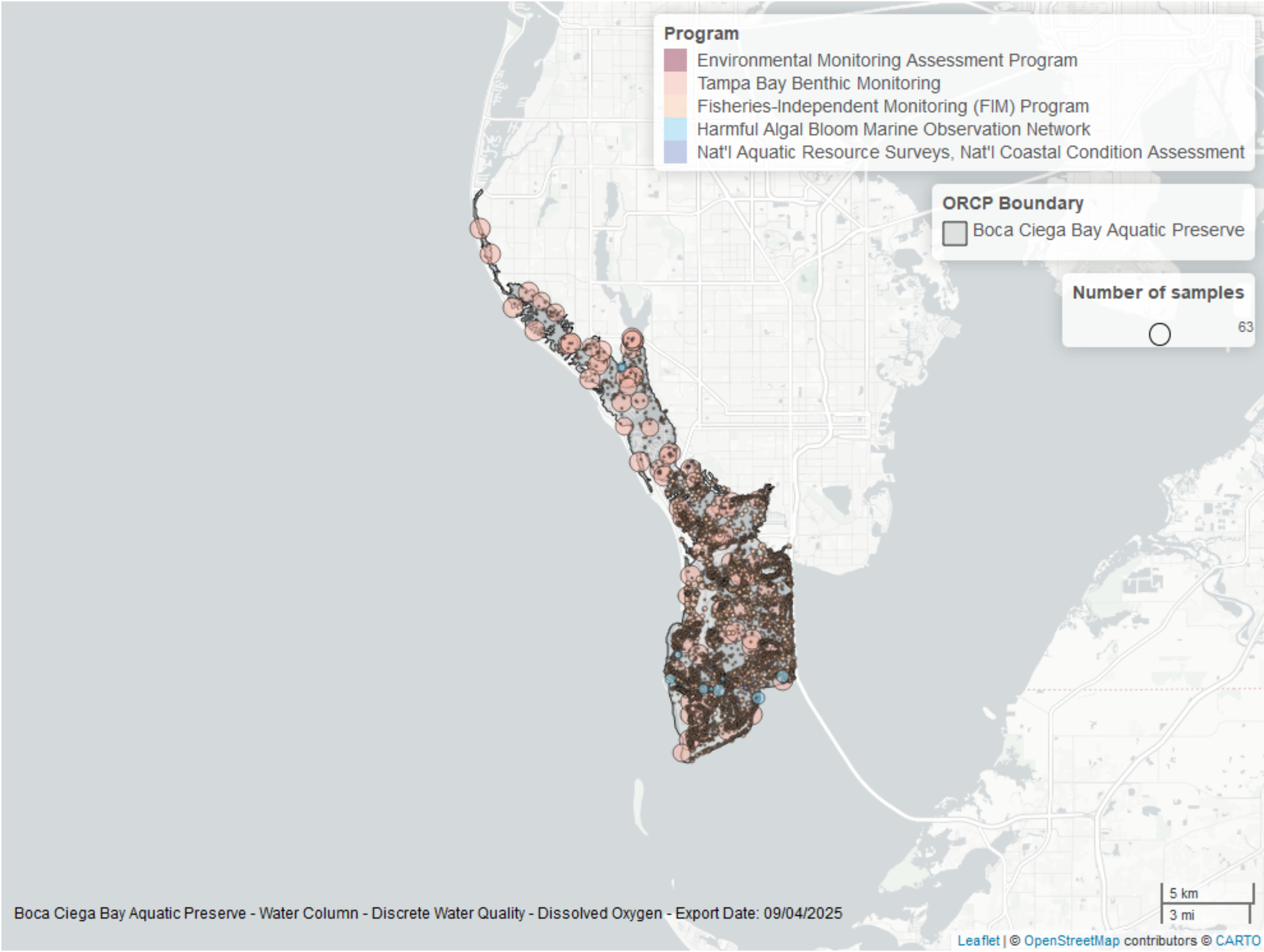

Figure 6: Map showing location of discrete water quality sampling locations within the boundaries of *Boca Ciega Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 11: Programs contributing data for Dissolved Oxygen

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	13990	1995	2025
69	10788	1989	2024
4067	5571	1995	2023
95	228	1974	2018
115	10	2000	2003
118	8	2000	2015
103	6	2015	2015

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program[6]
95 - Harmful Algal Bloom Marine Observation Network[2]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[3]
115 - Environmental Monitoring Assessment Program[4]
118 - National Aquatic Resource Surveys, National Coastal Condition Assessment[5]

4067 - Tampa Bay Benthic Monitoring[7]
5002 - Florida STORET / WIN[1]

Dissolved Oxygen Saturation - Discrete

Seasonal Kendall-Tau Trend Analysis

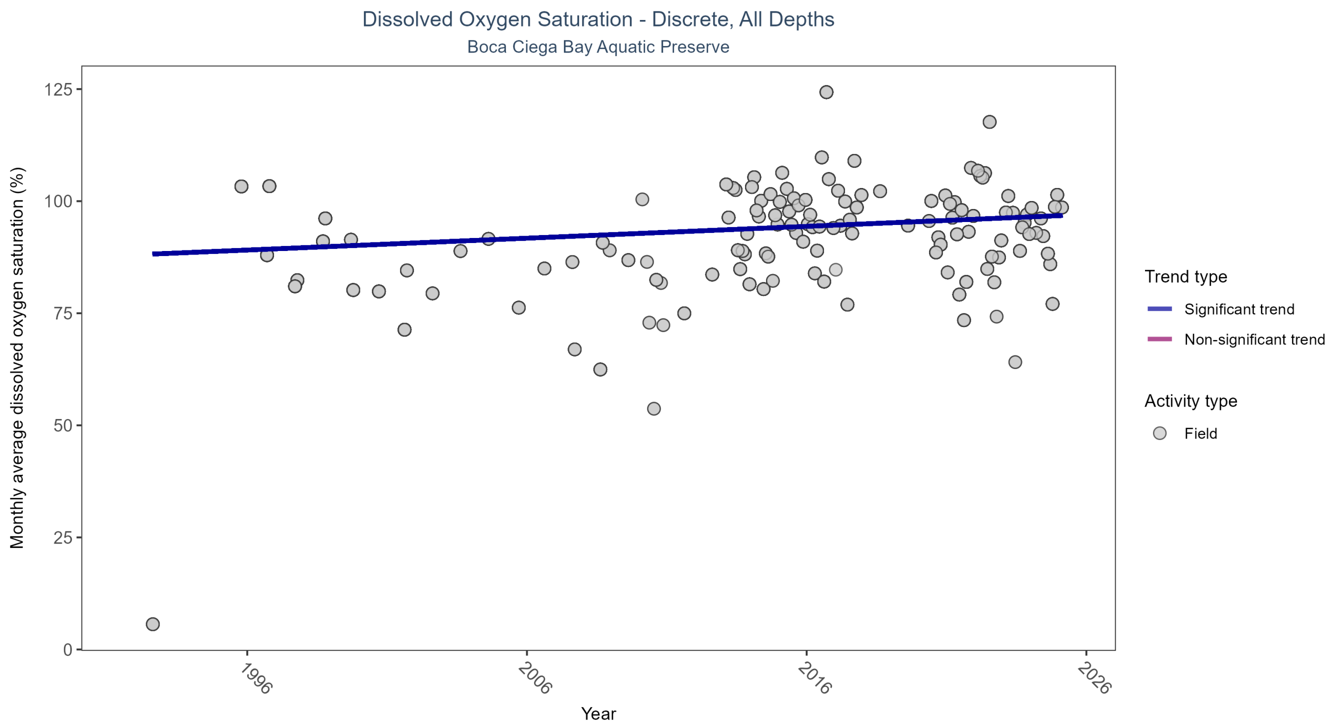

Figure 7: Scatter plot of monthly average dissolved oxygen saturation over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only dissolved oxygen saturation values measured in the field (circles)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

Table 12: 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	8088	32	1992 - 2025	91.1	0.1068	88.0408	0.2642	0.0427

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

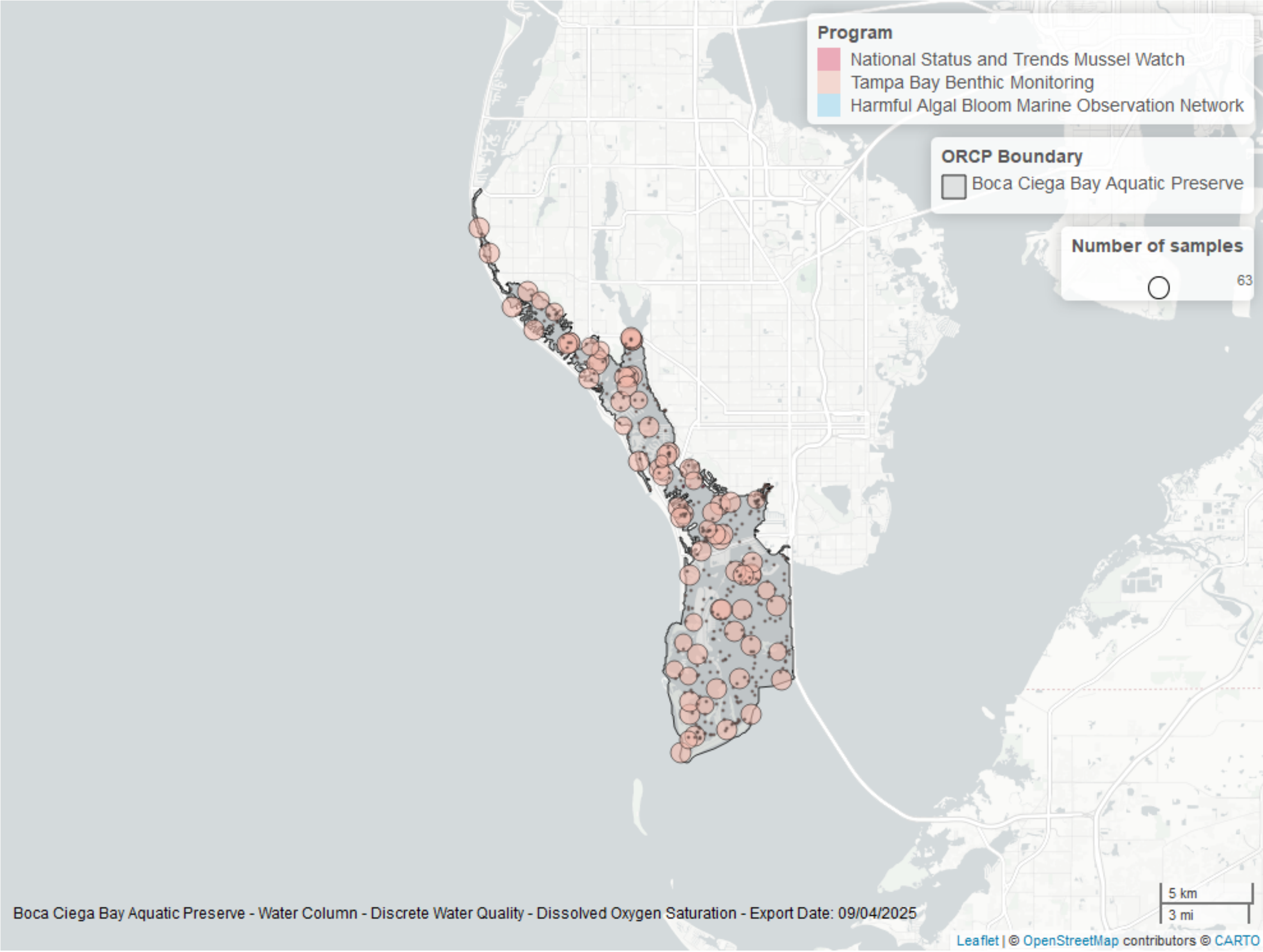

Figure 8: Map showing location of discrete water quality sampling locations within the boundaries of *Boca Ciega Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 13: Programs contributing data for Dissolved Oxygen Saturation

ProgramID	*N_Data*	*YearMin*	*YearMax*
4067	5110	1995	2023
5002	2971	2010	2025
102	10	1992	1992
95	1	2017	2017

Program names:

95 - Harmful Algal Bloom Marine Observation Network[2]
102 - National Status and Trends Mussel Watch[8]
4067 - Tampa Bay Benthic Monitoring[7]
5002 - Florida STORET / WIN[1]

pH - Discrete

Seasonal Kendall-Tau Trend Analysis

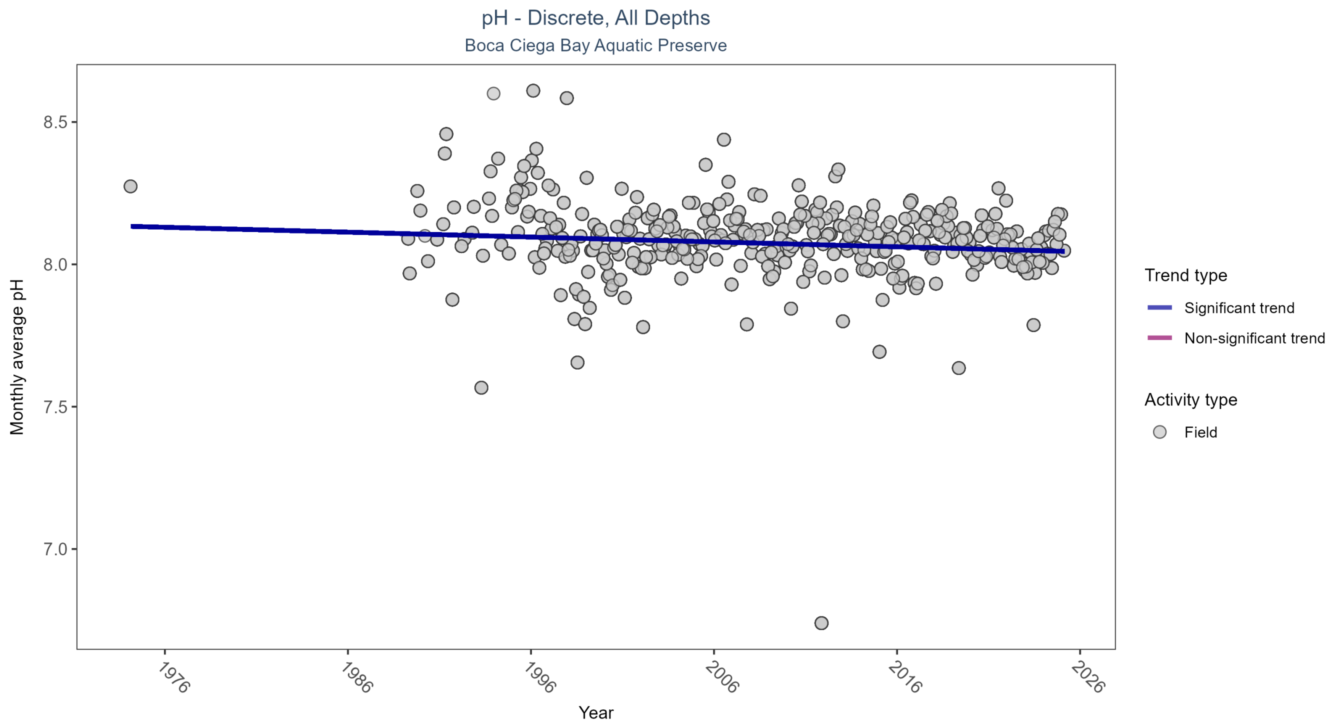

Figure 9: Scatter plot of monthly average pH over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only pH values measured in the field (circles) are included in the plot.

Table 14: 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	27836	38	1974 - 2025	8.1	-0.1133	8.1337	-0.0017	0.0014

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

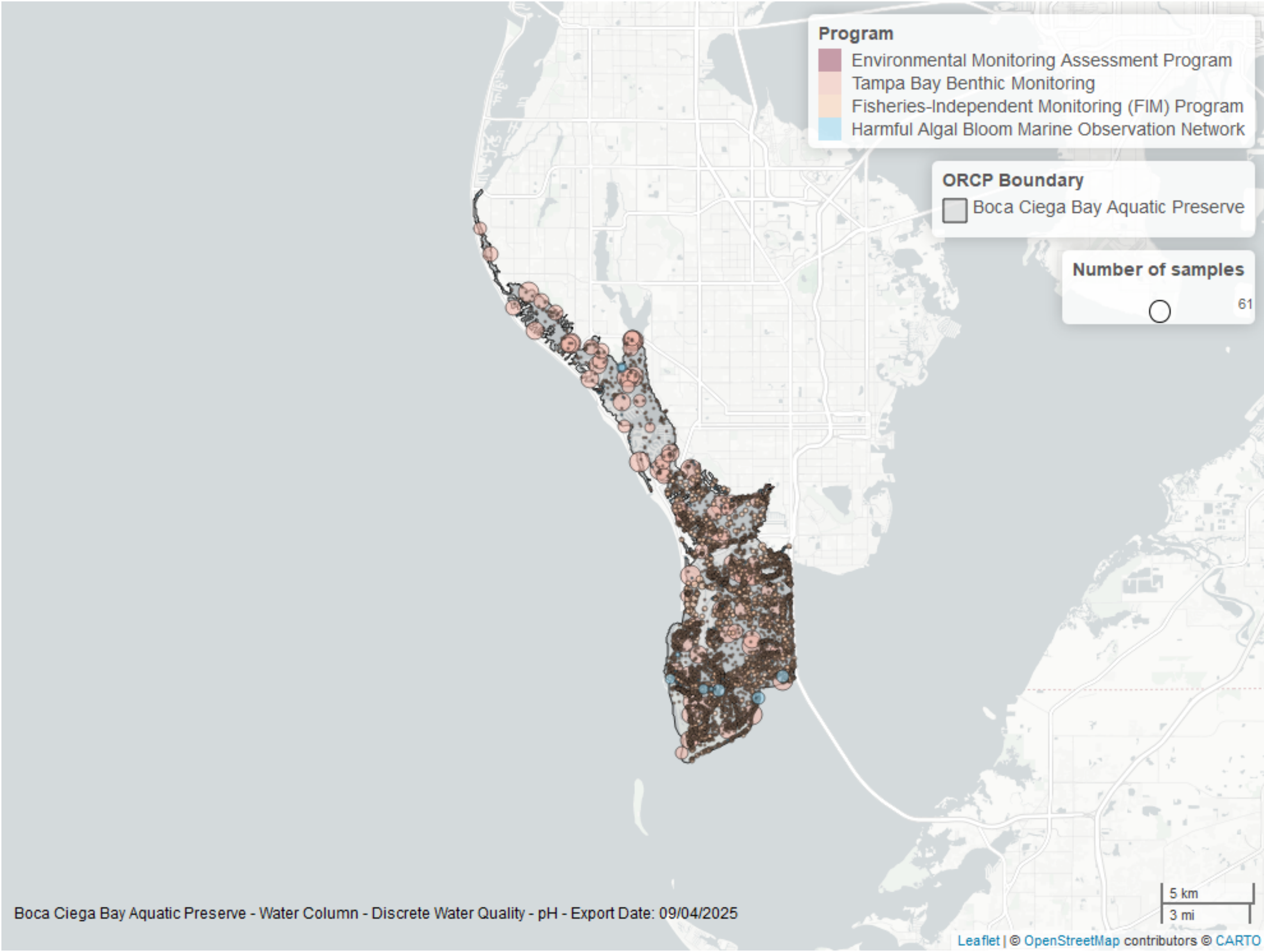

Figure 10: Map showing location of discrete water quality sampling locations within the boundaries of *Boca Ciega Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 15: Programs contributing data for pH

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	12858	1995	2025
69	10576	1989	2024
4067	4248	1995	2023
95	205	1974	2018
115	10	2000	2003
103	3	2015	2015

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program[6]
95 - Harmful Algal Bloom Marine Observation Network[2]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[3]
115 - Environmental Monitoring Assessment Program[4]
4067 - Tampa Bay Benthic Monitoring[7]
5002 - Florida STORET / WIN[1]

Salinity - Discrete

Seasonal Kendall-Tau Trend Analysis

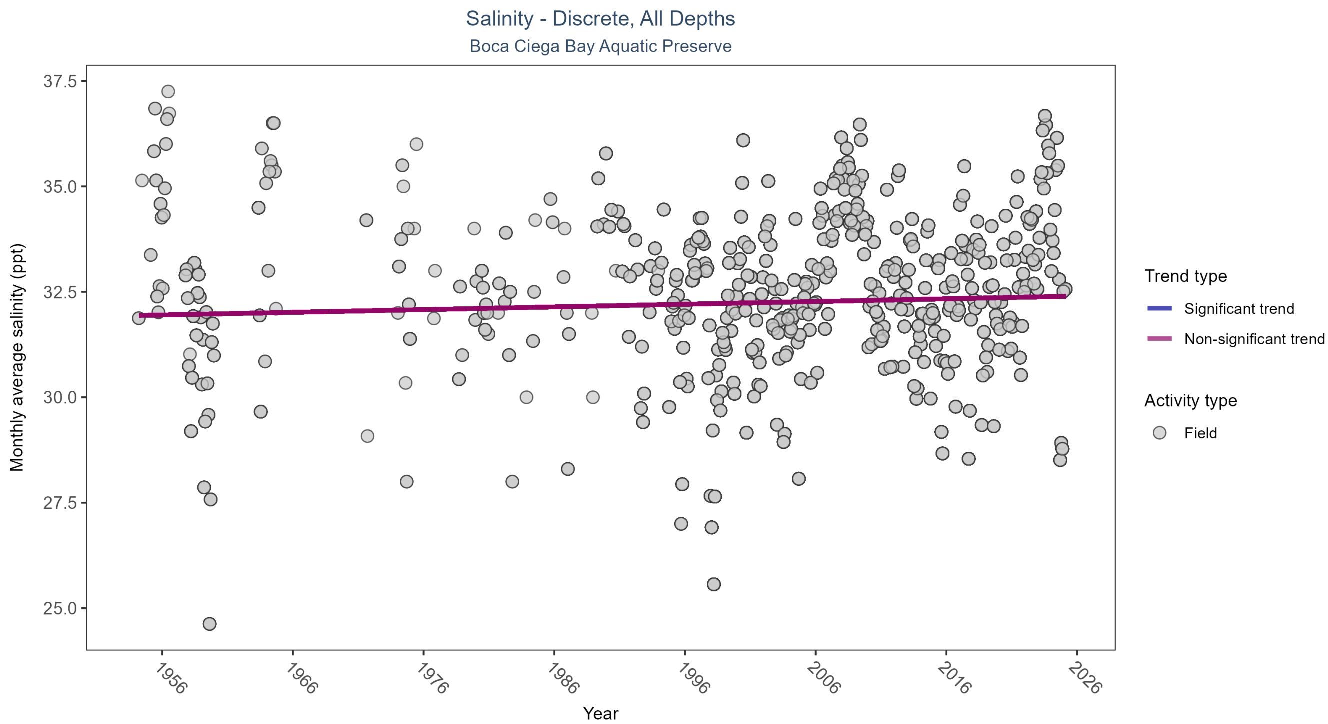

Figure 11: Scatter plot of monthly average salinity over time. If the time series included ten or more years of discrete observations, significant (blue) or non-significant (magenta) trend lines are also shown. Discrete salinity values derived from grab samples analyzed in the field (circles) or the laboratory (triangles) are both included in the plot.

Table 16: 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	No significant trend	28282	60	1954 - 2025	32.64	0.0509	31.9378	0.0064	0.1348

Salinity showed no detectable trend between 1954 and 2025.

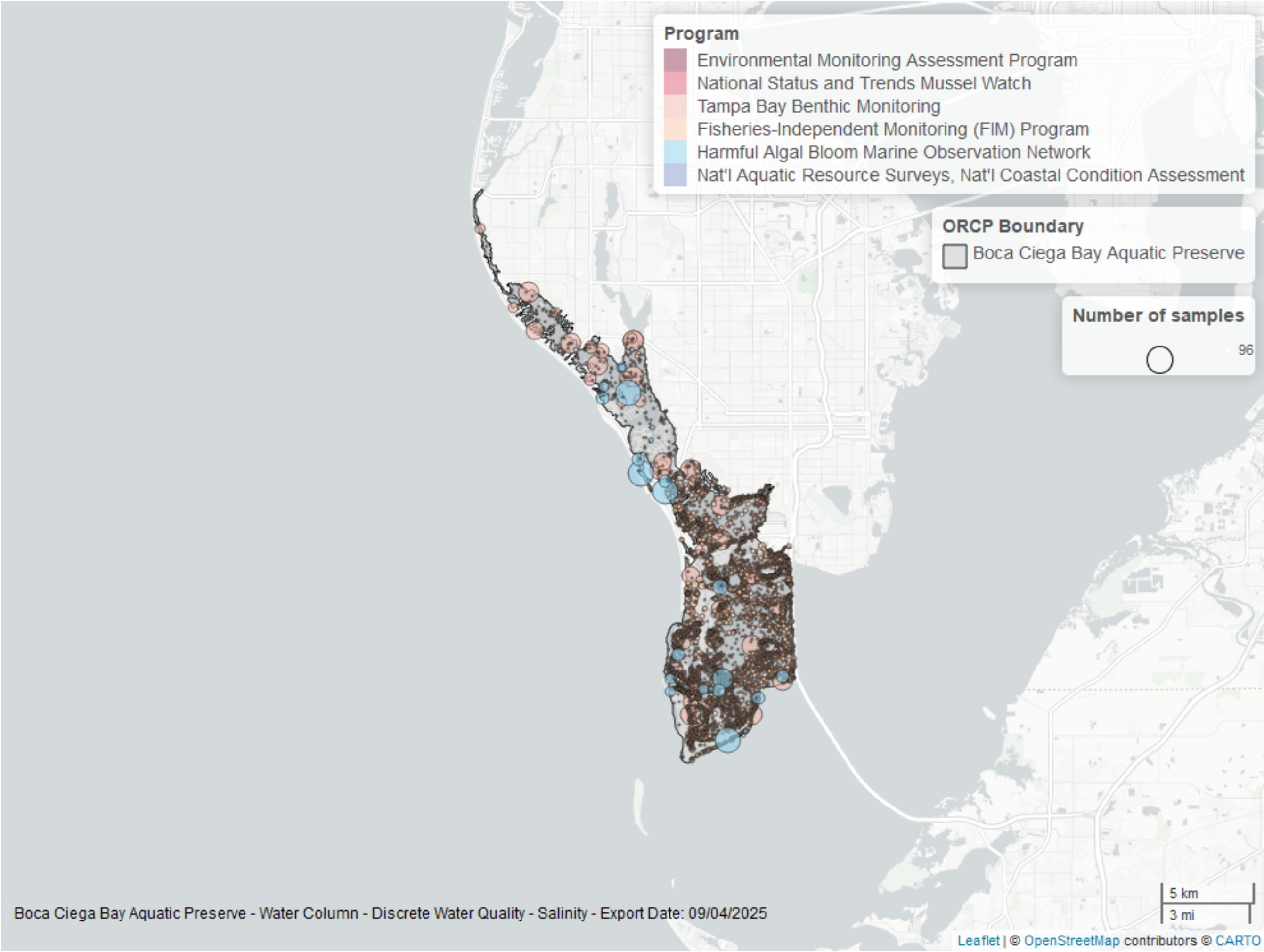

Figure 12: Map showing location of discrete water quality sampling locations within the boundaries of *Boca Ciega Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 17: Programs contributing data for Salinity

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	14015	1995	2025
69	10821	1989	2024
4067	2564	1995	2023
95	909	1954	2018
115	10	2000	2003
102	10	1992	1992
118	2	2015	2015

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program[6]
95 - Harmful Algal Bloom Marine Observation Network[2]
102 - National Status and Trends Mussel Watch[8]
115 - Environmental Monitoring Assessment Program[4]
118 - National Aquatic Resource Surveys, National Coastal Condition Assessment[5]

4067 - Tampa Bay Benthic Monitoring[7]
5002 - Florida STORET / WIN[1]

Secchi Depth - Discrete

Seasonal Kendall-Tau Trend Analysis

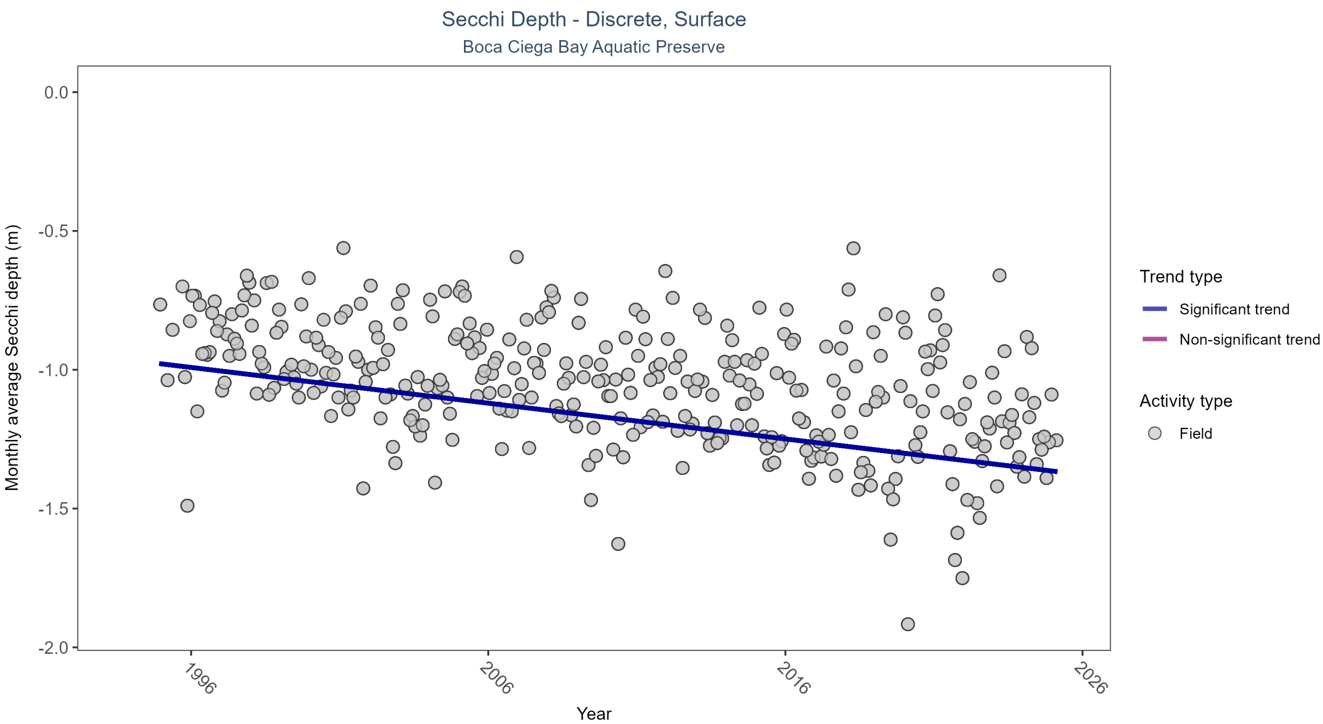

Figure 13: Scatter plot of monthly average Secchi depth over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Secchi depth is only measured in the field (circles).

Table 18: Seasonal Kendall-Tau 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	10274	32	1994 - 2025	-1.1	-0.3044	-0.9659	-0.0129	0

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

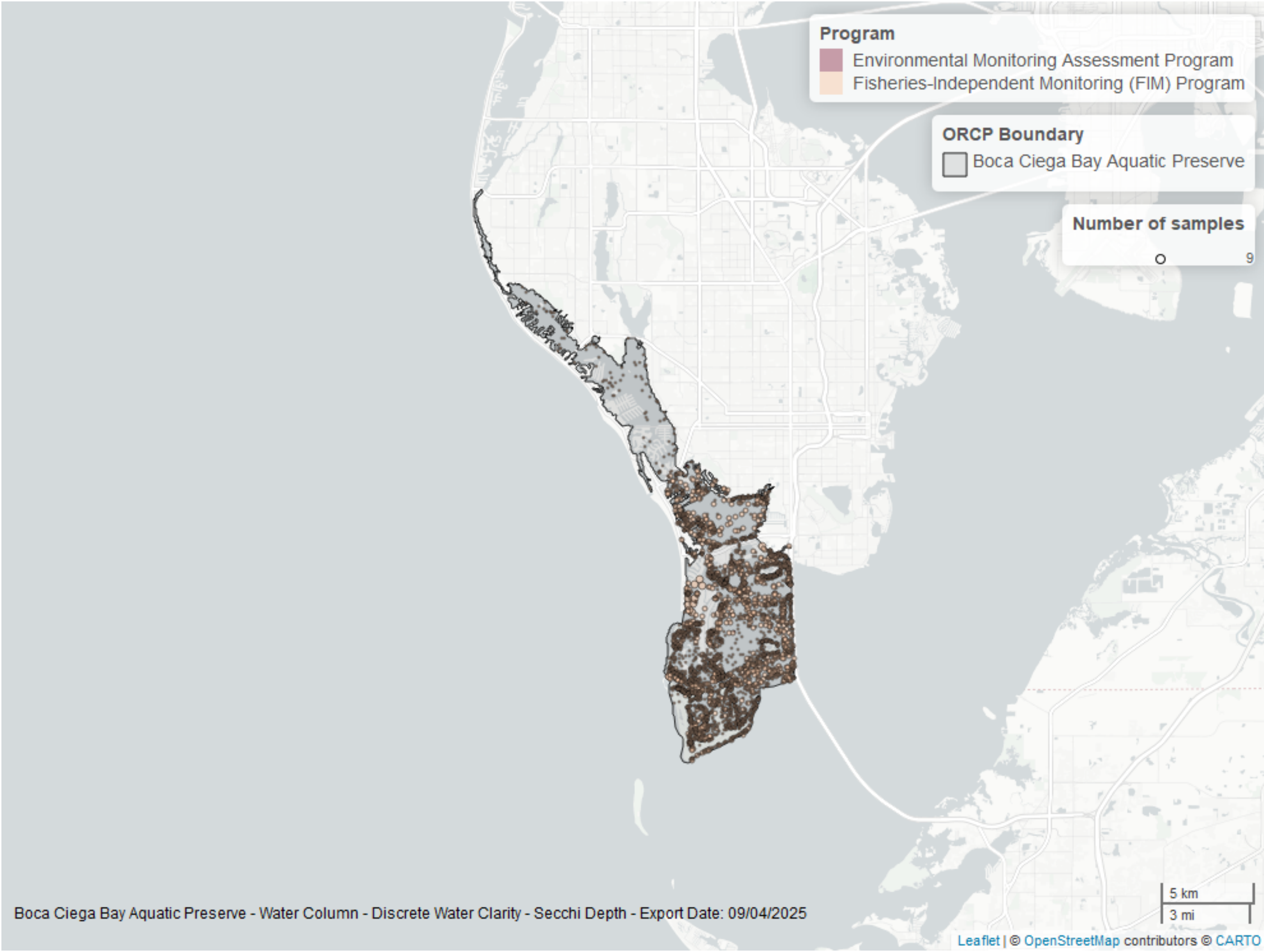

Figure 14: Map showing location of discrete water quality sampling locations within the boundaries of *Boca Ciega Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 19: Programs contributing data for Secchi Depth

ProgramID	*N_Data*	*YearMin*	*YearMax*
69	9739	1994	2024
5002	530	2010	2025
115	4	2000	2002
103	1	2015	2015

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program[6]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[3]
115 - Environmental Monitoring Assessment Program[4]
5002 - Florida STORET / WIN[1]

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

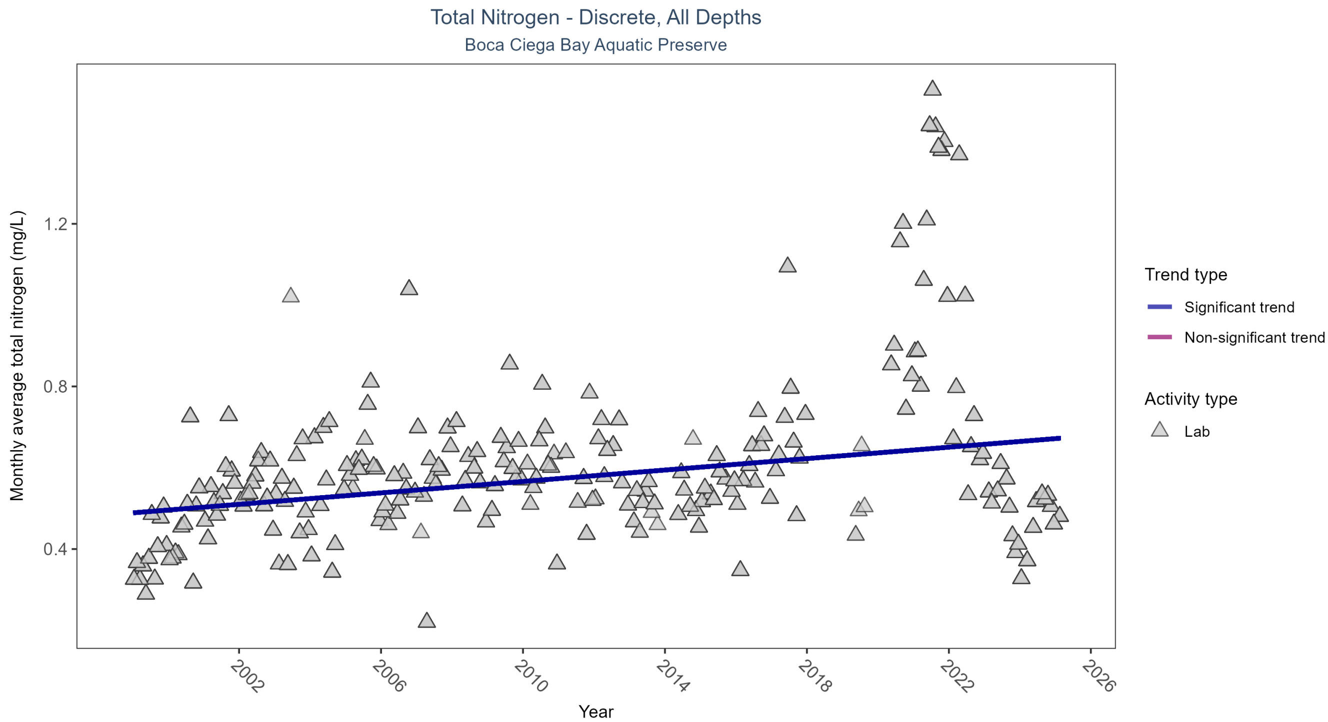

Figure 15: Scatter plot of monthly average total nitrogen over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only nitrogen values obtained from laboratory analyses (triangles) are included in the plot.

Table 20: 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	Significantly increasing trend	2977	26	1999 - 2025	0.55	0.2502	0.489	0.007	0

Monthly average total nitrogen increased by 0.01 mg/L per year.

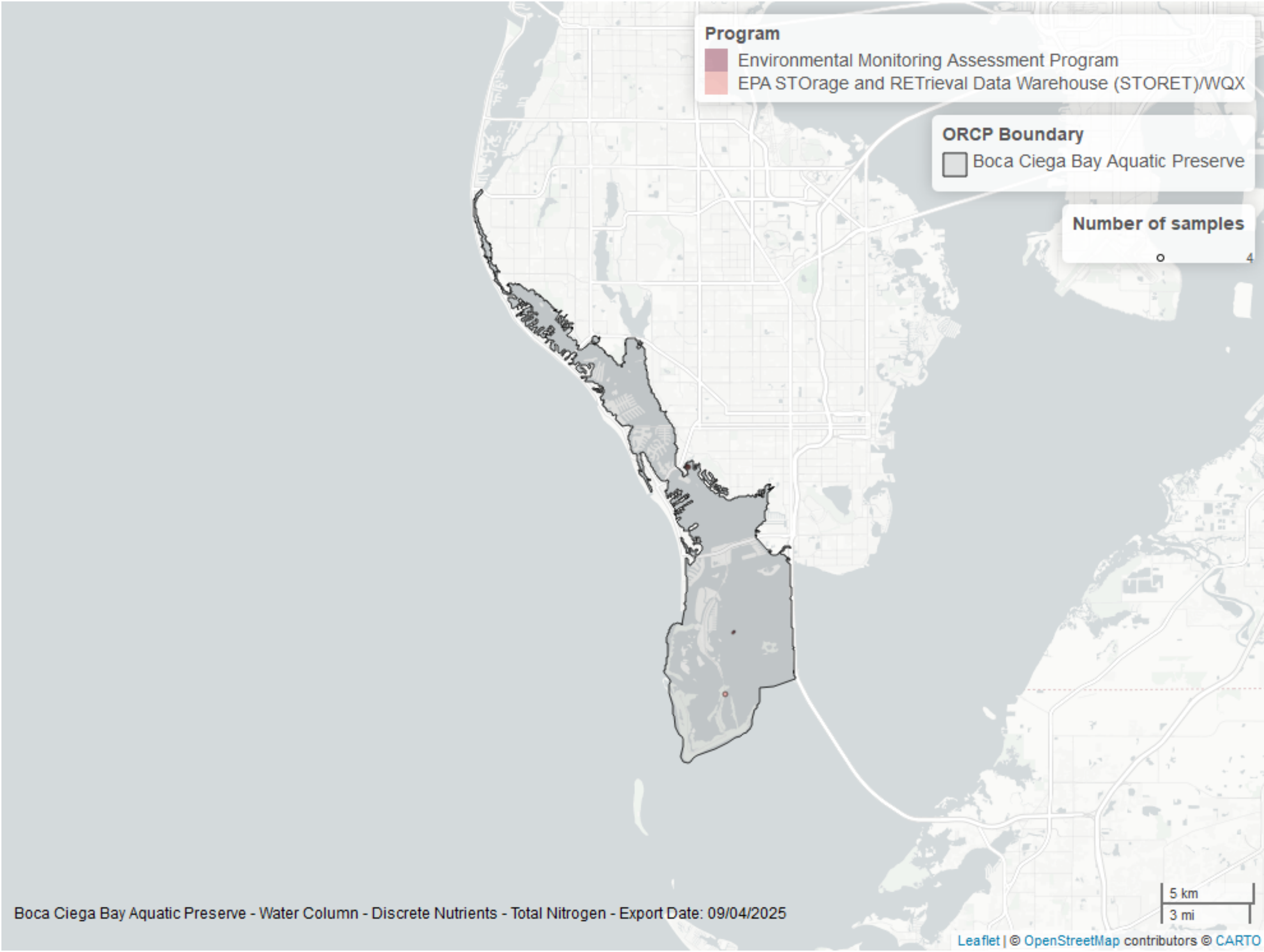

Figure 16: Map showing location of discrete water quality sampling locations within the boundaries of *Boca Ciega Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 21: Programs contributing data for Total Nitrogen

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	2961	1999	2025
103	11	2000	2003
115	5	2000	2003

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[3]
115 - Environmental Monitoring Assessment Program[4]
5002 - Florida STORET / WIN[1]

Total Phosphorus - Discrete

Seasonal Kendall-Tau Trend Analysis

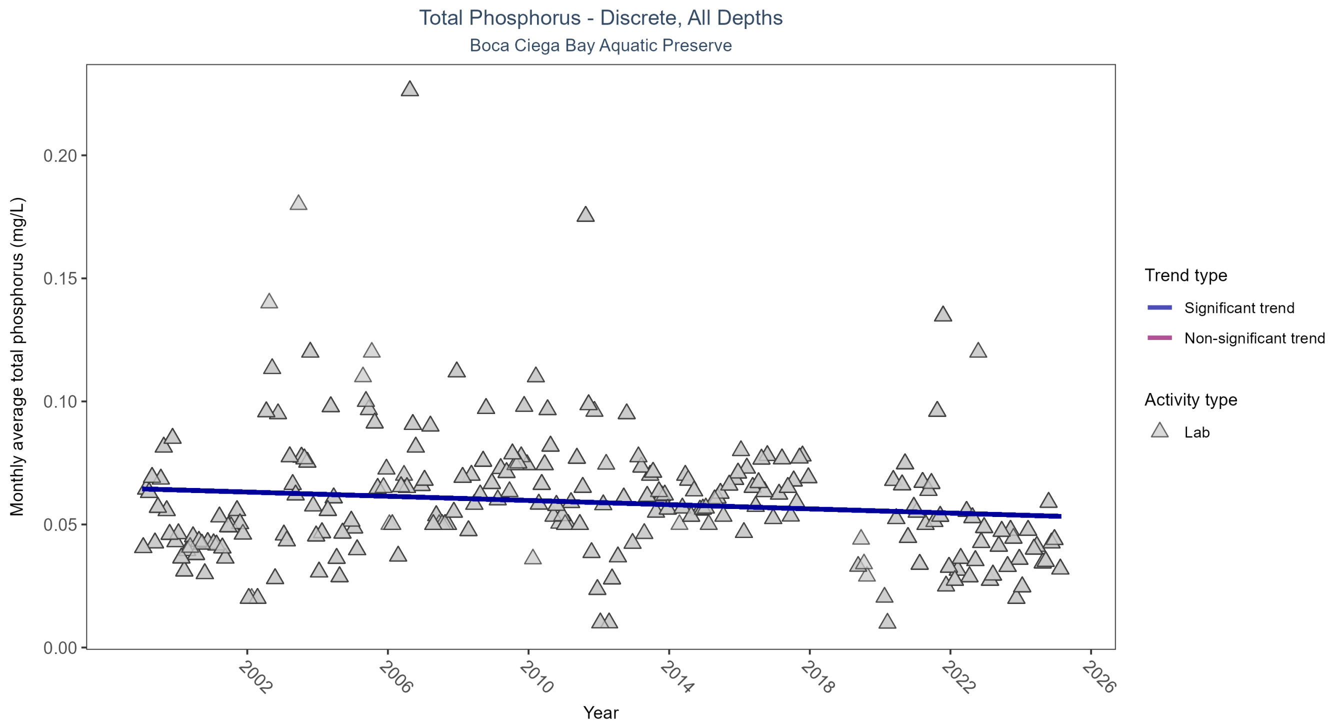

Figure 17: Scatter plot of monthly average total phosphorus over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only phosphorus values obtained from laboratory analyses (triangles) are included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

Table 22: 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	2732	26	1999 - 2025	0.05	-0.1118	0.0644	-0.0004	0.0106

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

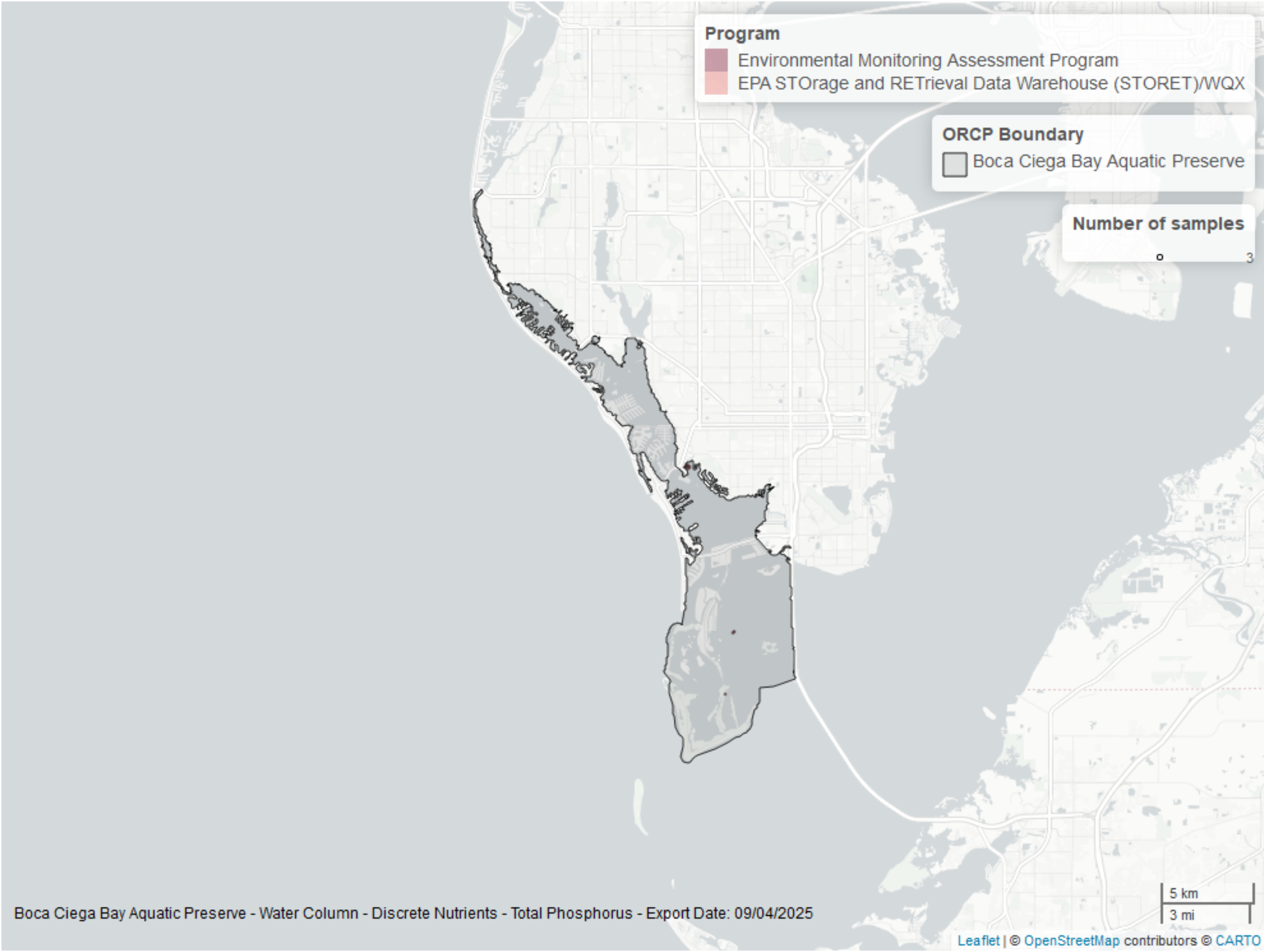

Figure 18: Map showing location of discrete water quality sampling locations within the boundaries of *Boca Ciega Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 23: Programs contributing data for Total Phosphorus

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	2751	1999	2025
103	10	2000	2015
115	5	2000	2003

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[3]
115 - Environmental Monitoring Assessment Program[4]
5002 - Florida STORET / WIN[1]

Total Suspended Solids - Discrete

Seasonal Kendall-Tau Trend Analysis

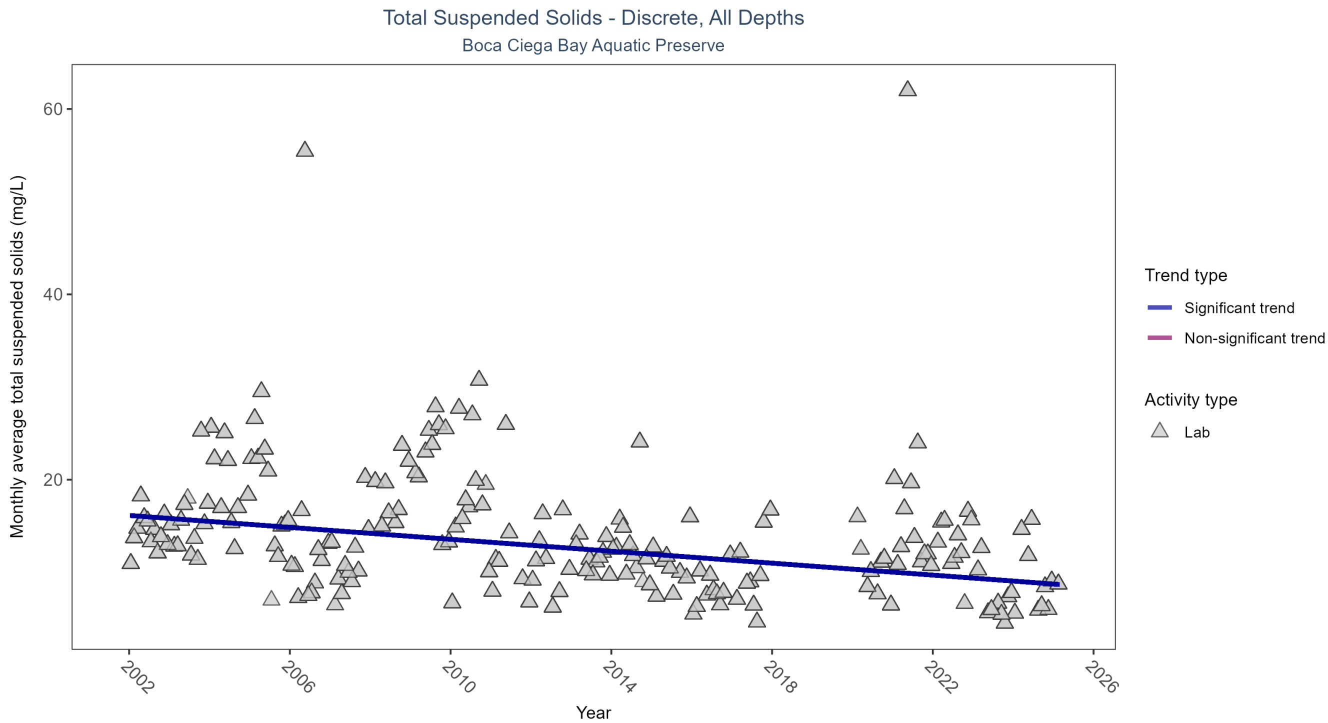

Figure 19: Scatter plot of monthly average total suspended solids (TSS) over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only TSS values obtained from laboratory analyses (triangles) are included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

Table 24: 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	2782	22	2002 - 2025	12	-0.3101	16.1446	-0.3218	0

Monthly average total suspended solids decreased by 0.32 mg/L per year, indicating an increase in water clarity.

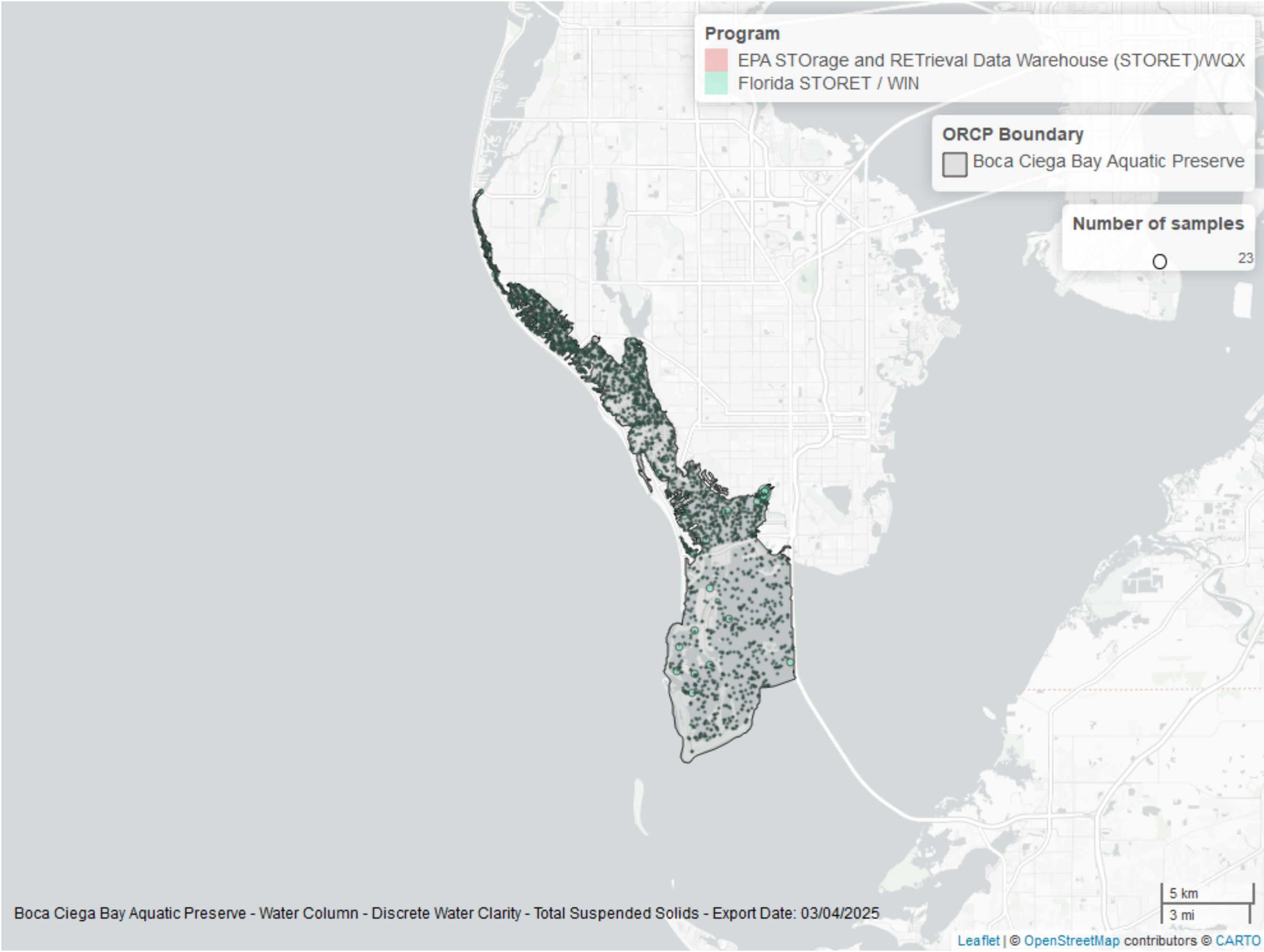

Figure 20: Map showing location of discrete water quality sampling locations within the boundaries of *Boca Ciega Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 25: Programs contributing data for Total Suspended Solids

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	2795	2001	2025

Program names:

5002 - Florida STORET / WIN[1]

Turbidity - Discrete

Seasonal Kendall-Tau Trend Analysis

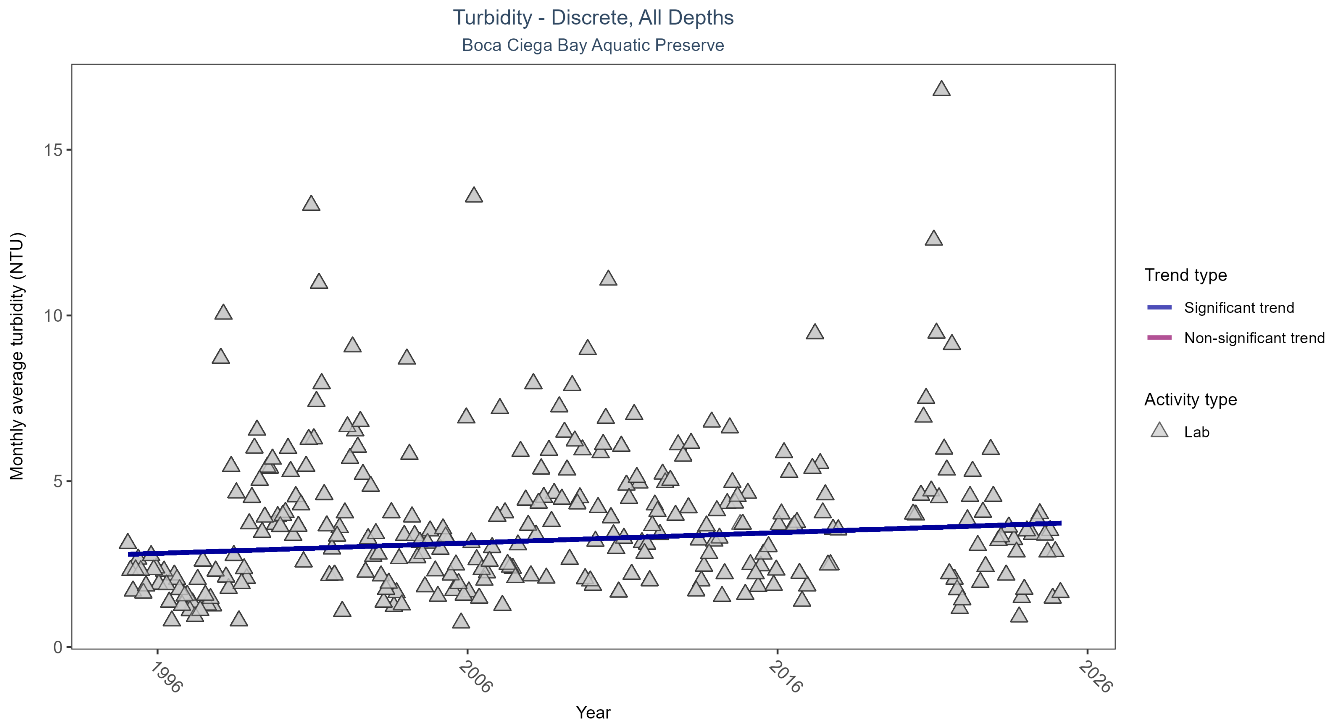

Figure 21: Scatter plot of monthly average turbidity over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only turbidity values measured in the laboratory (triangles) are included in the plot.

Table 26: 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	7053	29	1995 - 2025	2.6	0.1119	2.7911	0.0313	0.0053

Monthly average turbidity increased by 0.03 NTU per year, indicating a decrease in water clarity.

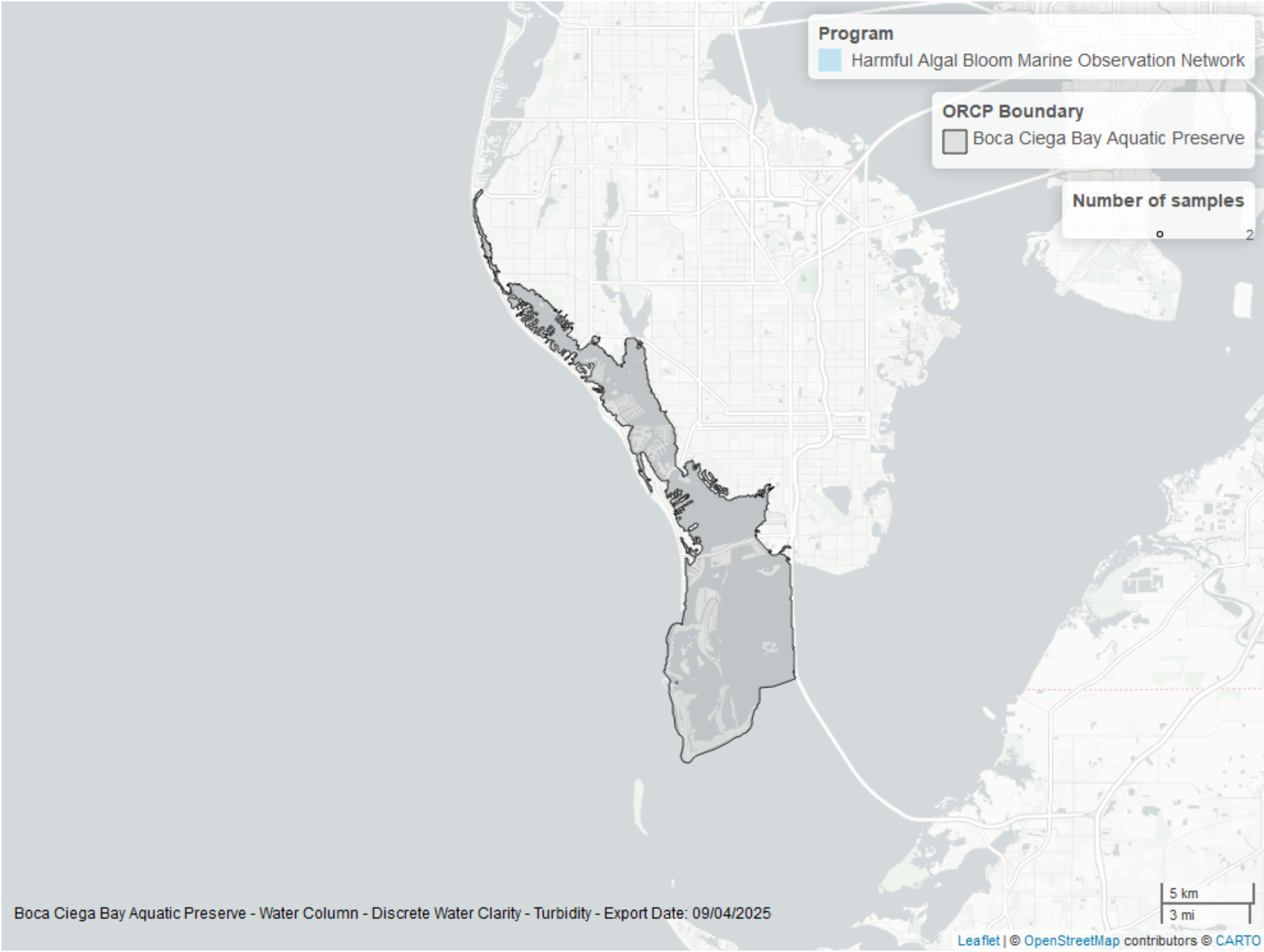

Figure 22: Map showing location of discrete water quality sampling locations within the boundaries of *Boca Ciega Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 27: Programs contributing data for Turbidity

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	7139	1995	2025
95	2	2004	2004

Program names:

95 - Harmful Algal Bloom Marine Observation Network[2]
5002 - Florida STORET / WIN[1]

Water Temperature - Discrete

Seasonal Kendall-Tau Trend Analysis

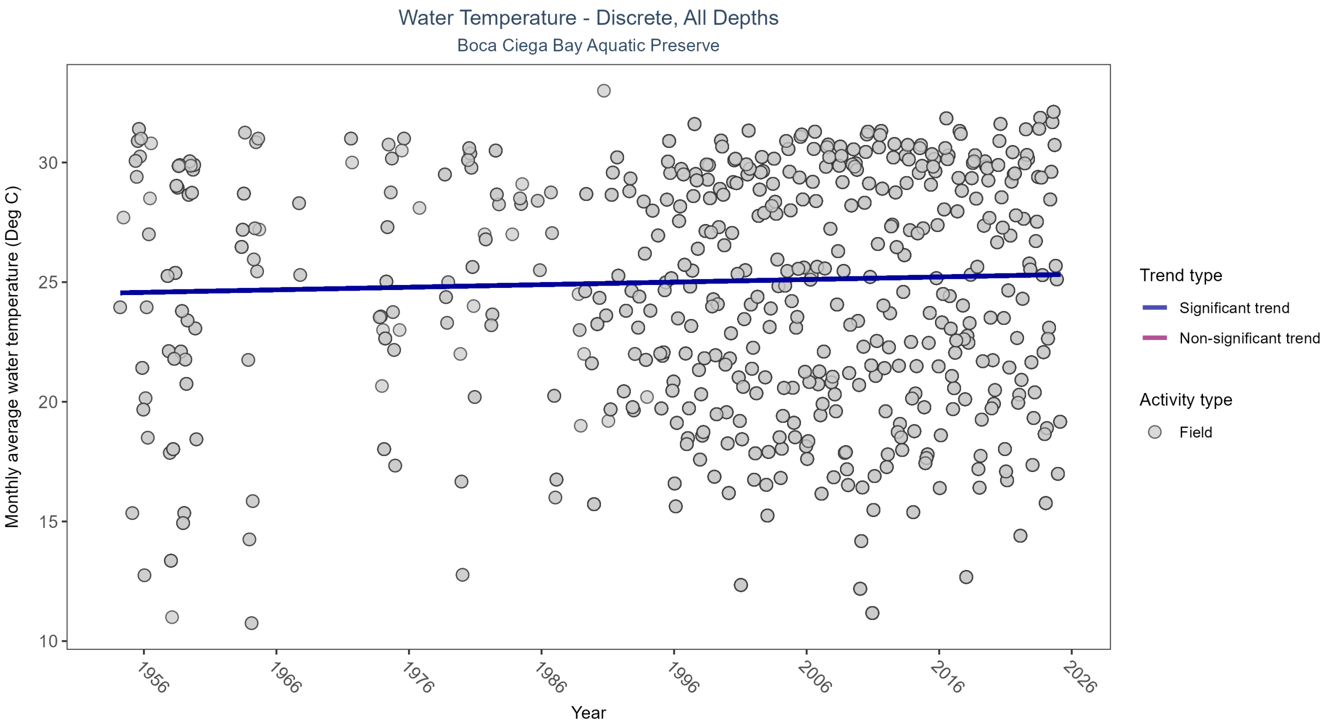

Figure 23: Scatter plot of monthly average water temperature over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only water temperature measurements taken in the field (circles) are included in the plot.

Table 28: 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	31128	62	1954 - 2025	27.1	0.0869	24.5507	0.0108	0.0055

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

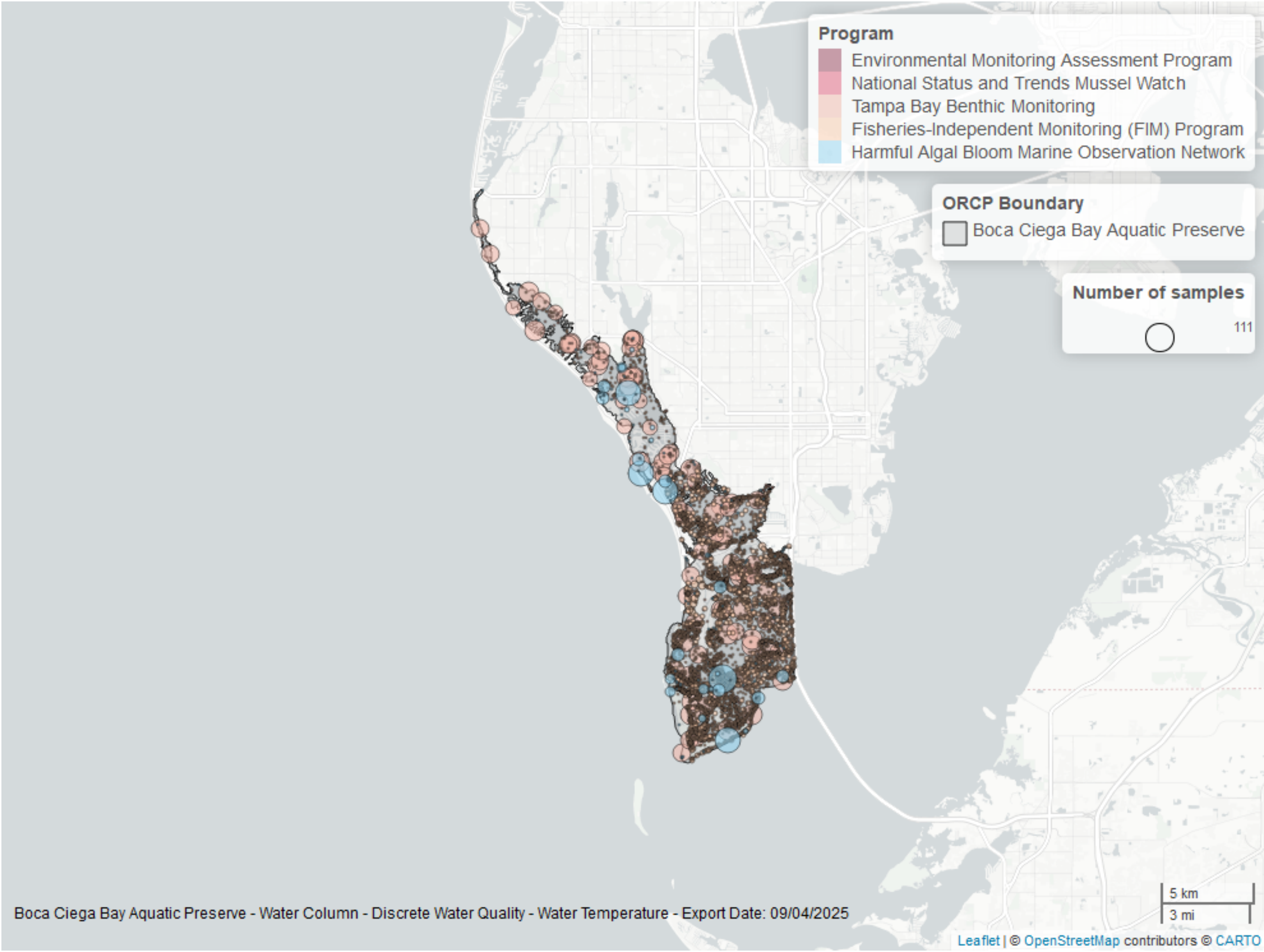

Figure 24: Map showing location of discrete water quality sampling locations within the boundaries of *Boca Ciega Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 29: Programs contributing data for Water Temperature

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	14270	1995	2025
69	10843	1989	2024
4067	5015	1995	2023
95	981	1954	2018
115	10	2000	2003
102	10	1992	1992

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program[6]
95 - Harmful Algal Bloom Marine Observation Network[2]
102 - National Status and Trends Mussel Watch[8]
115 - Environmental Monitoring Assessment Program[4]
4067 - Tampa Bay Benthic Monitoring[7]
5002 - Florida STORET / WIN[1]

Submerged Aquatic Vegetation

The data file used is: **All__SAV__Parameters-2025-Sep-04.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

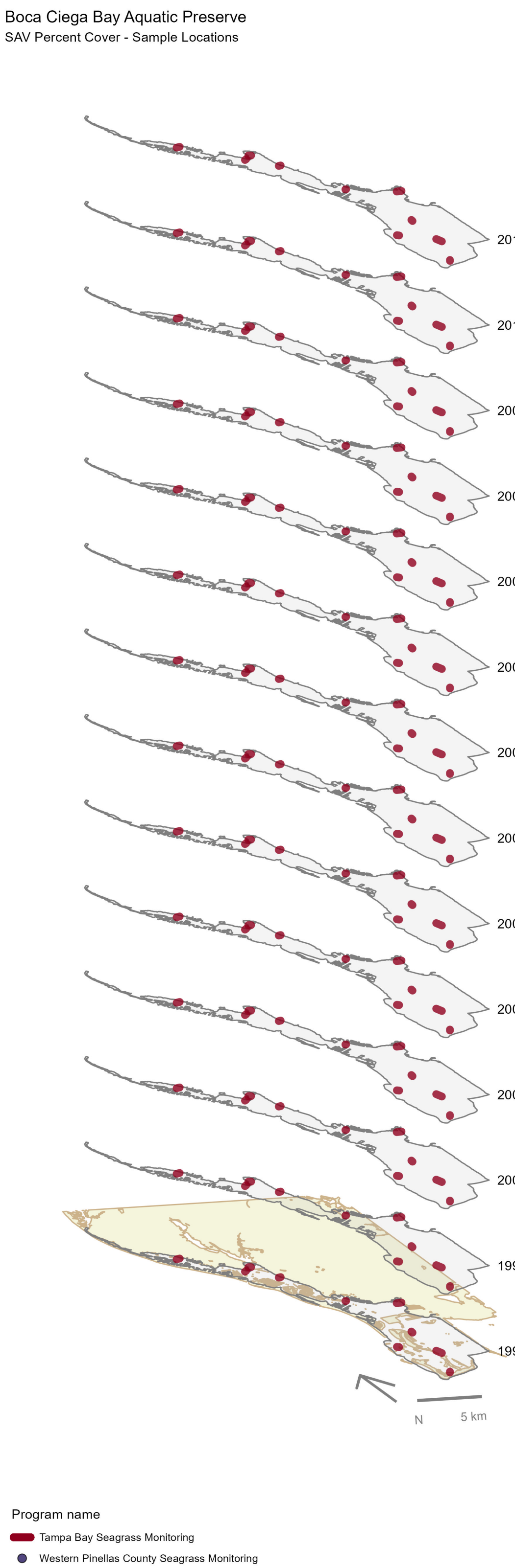

Figure 25: Maps showing the temporal scope of SAV sampling sites within the boundaries of *Boca Ciega Bay Aquatic Preserve* by Program name.

Click here to view spatio-temporal plots on GitHub.

Sampling locations by Program:

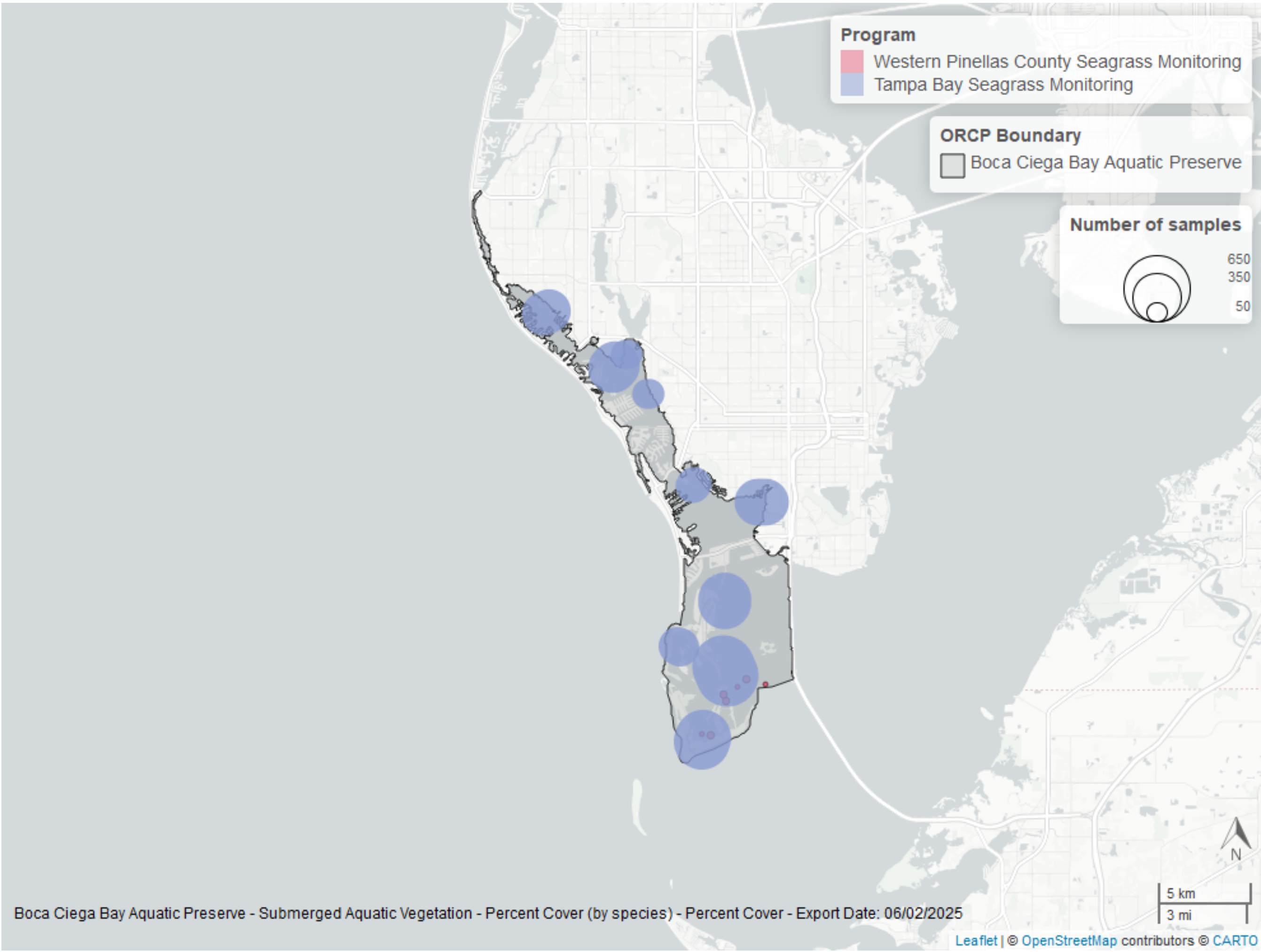

Figure 26: Map showing SAV sampling sites within the boundaries of *Boca Ciega Bay Aquatic Preserve*. The point size reflects the number of samples at a given sampling site.

Table 30: Program Information for Submerged Aquatic Vegetation

ProgramID	*N-Data*	*YearMin*	*YearMax*	*method*	*Sample Locations*
565	2730	1998	2024	Braun Blanquet	10
564	54	2019	2019	Percent Cover	7

Program names:

564 - Western Pinellas County Seagrass Monitoring[9]
565 - Tampa Bay Seagrass Monitoring[10]

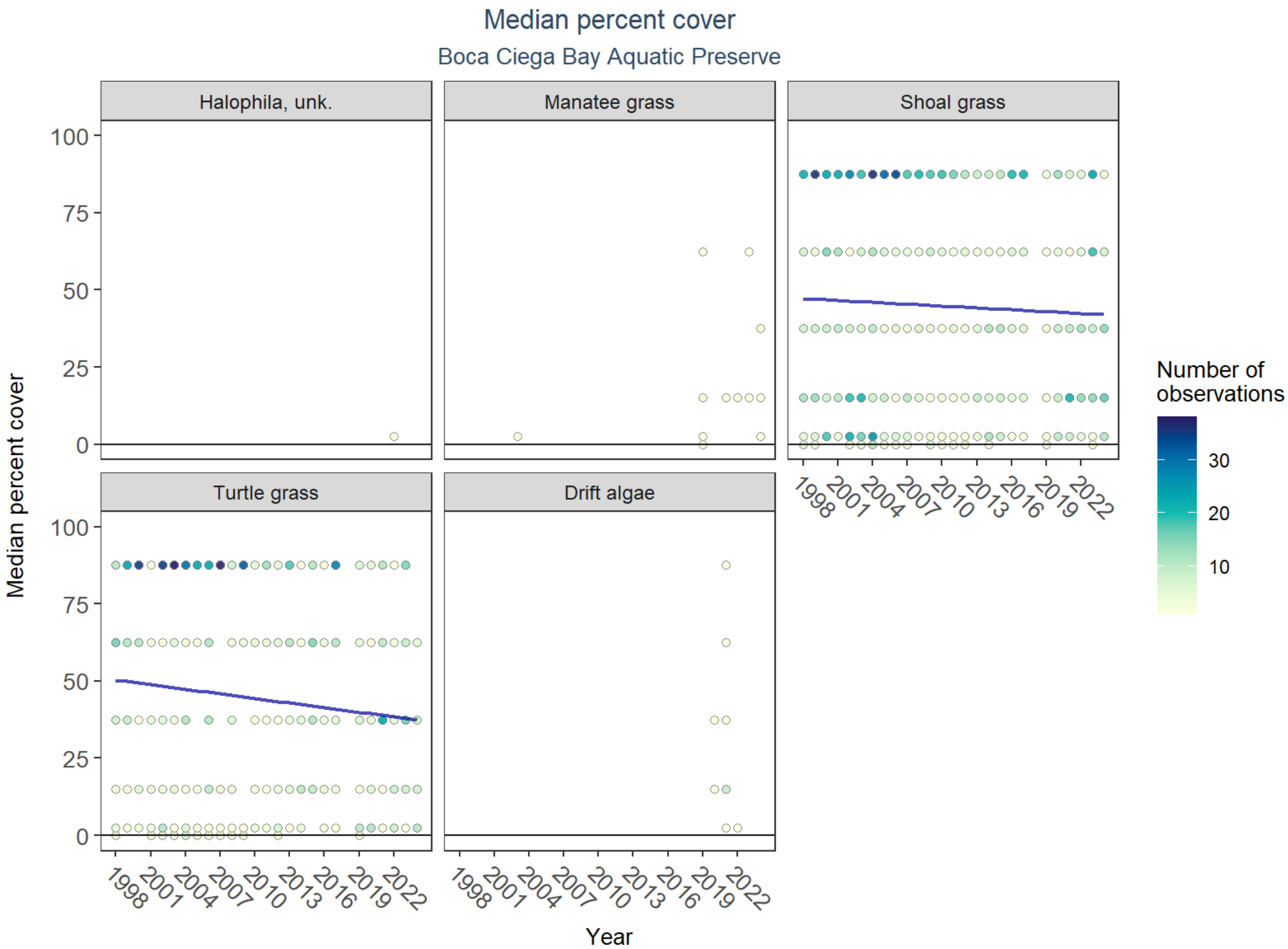

Figure 27: Scatter plots of median percent cover of submerged aquatic vegetation over time by group. Plots for time series that included five or more years of observations show the estimated trend as a blue line.

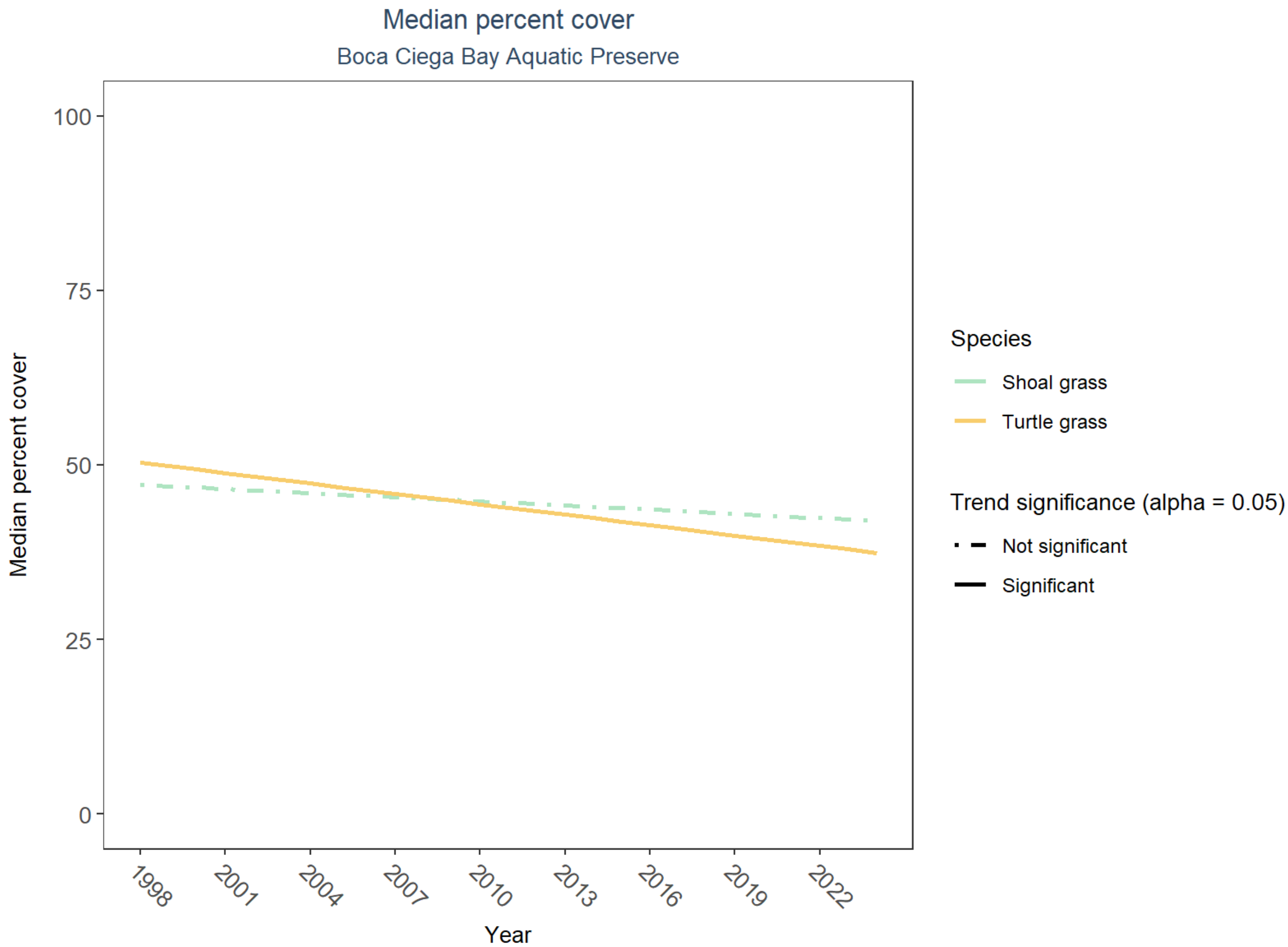

Figure 28: Trends in median percent cover for various seagrass species in Boca Ciega Bay Aquatic Preserve - simplified

Table 31: Percent Cover Trend Analysis for Boca Ciega Bay Aquatic Preserve

CommonName	*Trend Significance (0.05)*	*Period of Record*	*LME-Intercept*	*LME-Slope*	*p*
Drift algae	Insufficient data to calculate trend	-	-	-	-
Shoal grass	No significant trend	1998 - 2024	47.97762	-0.198289	0.3776091
No grass in quadrat	Model did not fit the available data	1998 - 2024	-	-	-
Manatee grass	Model did not fit the available data	2003 - 2024	-	-	-
Turtle grass	Significantly decreasing trend	1998 - 2024	52.32631	-0.496445	0.0492310
Halophila, unk.	Insufficient data to calculate trend	-	-	-	-

An annual decrease in percent cover was observed for turtle grass (-0.5%). No detectable change in percent cover was observed for shoal grass. Trends in percent cover could not be evaluated for unknown *Halophila* and drift algae due to insufficient data, and the model could not be fitted for manatee grass.

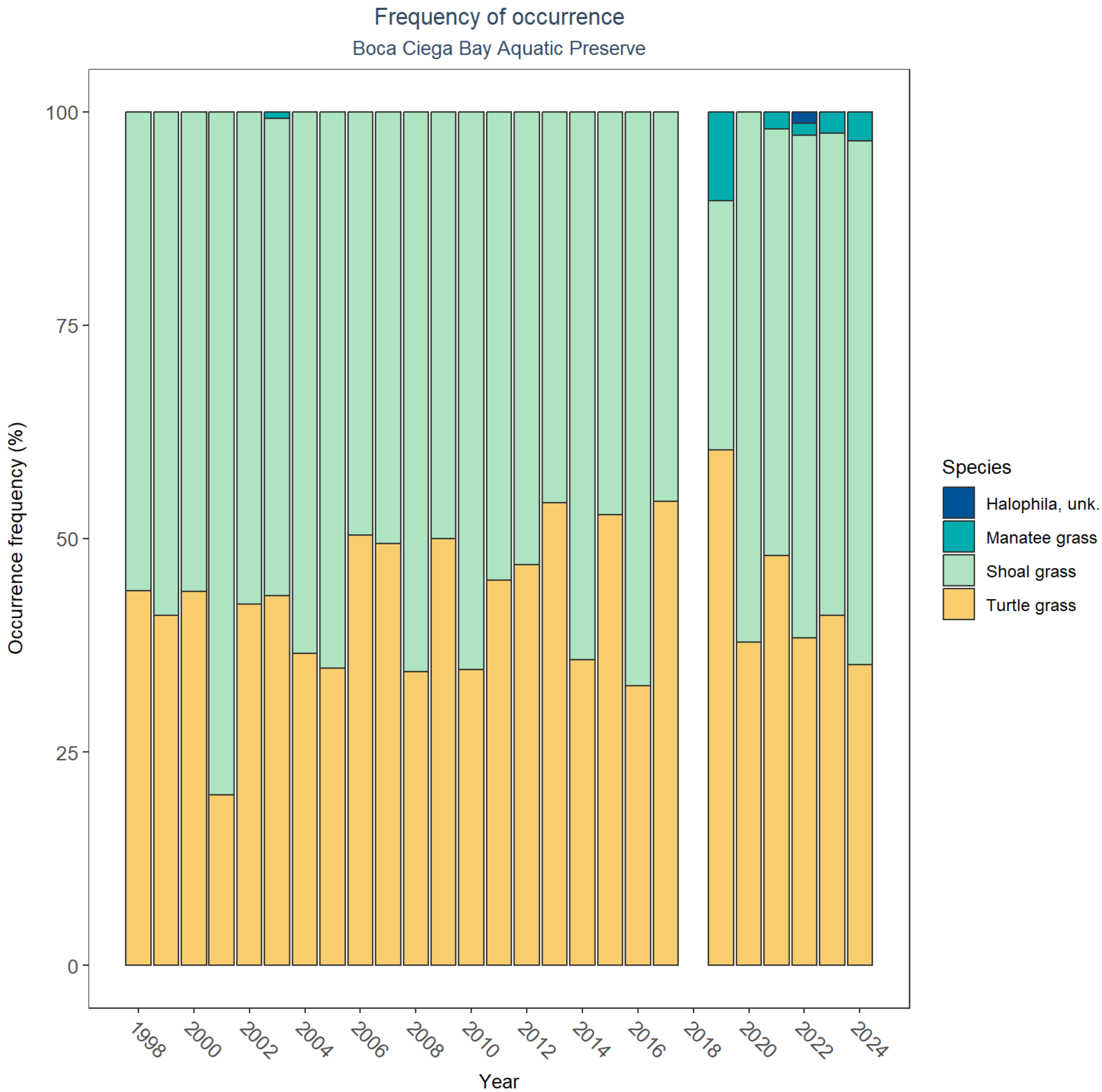

Figure 29: Frequency of occurrence for various seagrass species in Boca Ciega Bay Aquatic Preserve

SAV Water Column Analysis

The following parameters are available for Boca Ciega Bay Aquatic Preserve within the SAV_WC_Report:

- Chlorophyll a
- Dissolved Oxygen
- Dissolved Oxygen Saturation
- pH
- Salinity
- Secchi Depth

- Water Temperature
- Total Nitrogen
- Total Suspended Solids
- Turbidity

Access the reports here: DRAFT_SAV_WC_Report_2024-11-20.pdf

Nekton

The data file used is: **All_NEKTON_Parameters-2025-Sep-04.txt**

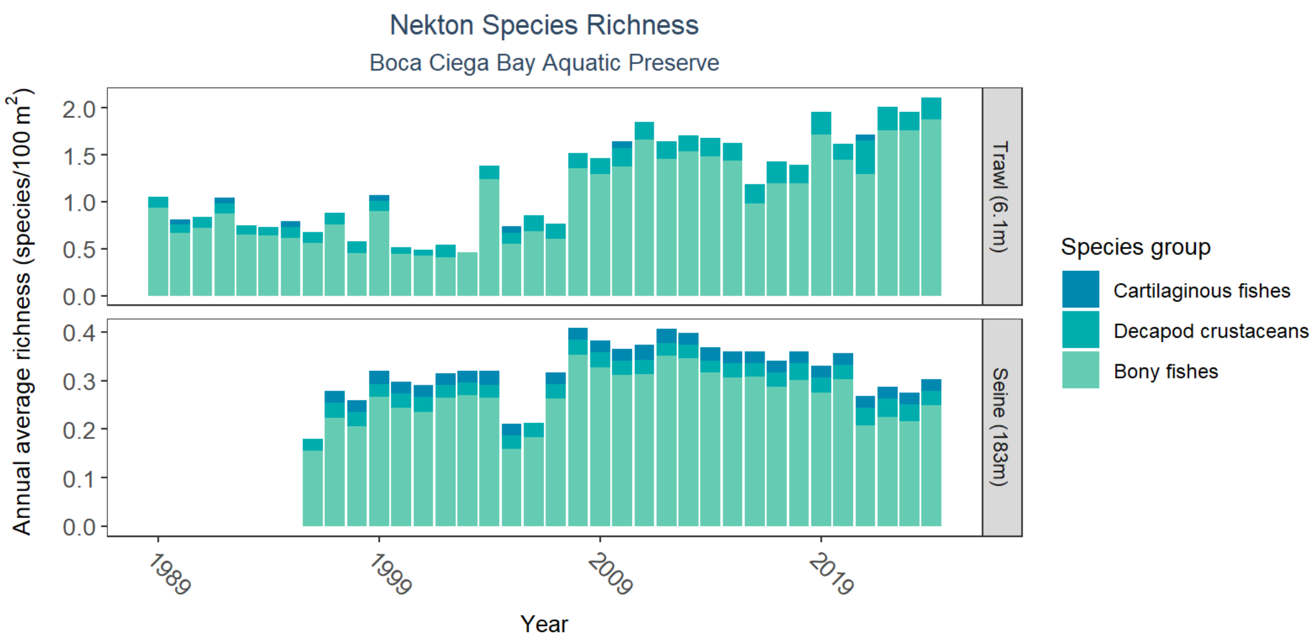

Figure 30: Bar graph(s) of annual average nekton richness over time for species groups occurring in at least 1% of samples. The bar colors represent species groups including bony fishes, cartilaginous fishes, decapod crustaceans (e.g., shrimps, crabs, and lobsters), and cephalopods (e.g., squid). Gear types and sizes are indicated in the panel label.

Table 32: Nekton Species Richness

Gear Type	*Sample Count*	*Number of Years*	*Period of Record*	*Median N of Taxa*	*Mean N of Taxa*
Trawl (6.1)	1833	36	1989 - 2024	0.45	0.77
Seine (183)	1747	29	1996 - 2024	0.15	0.19

The median annual number of taxa was 0.15 based on 1,747 observations collected by 183-meter seine between 1996 and 2024, and the median annual number of taxa was 0.45 based on 1,833 observations collected by 6.1-meter trawl between 1989 and 2024.

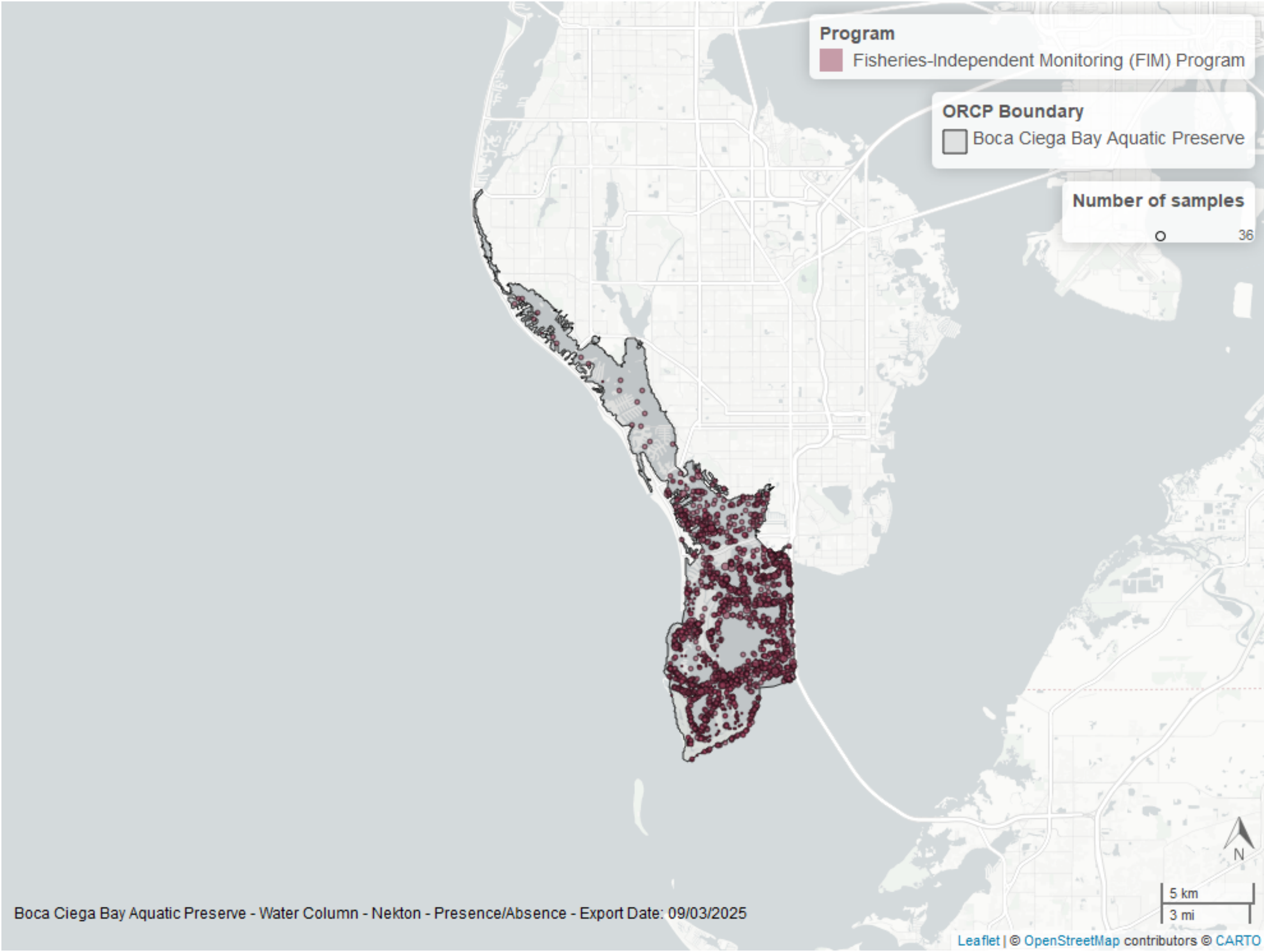

Figure 31: Map showing location of nekton sampling locations within the boundaries of *Boca Ciega Bay Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Species list

Acanthophora sp.[1]	Etropus crossotus[2]	No fish
Acanthostracion quadricornis[2]	Eucinostomus argenteus[2]	No grass in quadrat[1]
Achirus lineatus[2]	Eucinostomus gula[2]	Ocyurus chrysurus[2]
Aetobatus narinari[2]	Eucinostomus harengulus[2]	Ogcocephalus cubifrons[2]
Albula vulpes[2]	Eucinostomus spp.[2]	Ogcocephalus spp.[2]
Alpheidae spp.[2]	Eugerres plumieri[2]	Oligoplites saurus[2]
Aluterus schoepfii[2]	Floridichthys carpio[2]	Ophidion grayi[2]
Aluterus scriptus[2]	Fundulus grandis[2]	Ophidion holbrookii[2]
Anarchopterus criniger[2]	Fundulus similis[2]	Ophidion josephi[2]
Anchoa cubana[2]	Gerres cinereus[2]	Opisthonema oglinum[2]
Anchoa hepsetus[2]	Gobiesox strumosus[2]	Opsanus beta[2]
Anchoa lyolepis[2]	Gobiidae spp.[2]	Oreochromis aureus[2]
Anchoa mitchilli[2]	Gobionellus oceanicus[2]	Orthopristis chrysoptera[2]
Anchoa spp.[2]	Gobiosoma bosc[2]	Ostraciidae spp.[2]
Ancylopsetta quadrocellata[2]	Gobiosoma longipala[2]	Paraclinus fasciatus[2]
Anguilla rostrata[2]	Gobiosoma robustum[2]	Paraclinus marmoratus[2]
Archosargus probatocephalus[2]	Gobiosoma spp.[2]	Paralichthys albigutta[2]
Argopecten irradians	Gracilaria sp.[1]	Penaeidae spp.[2]
Argopecten spp.	Haemulon aurolineatum[2]	Penaeus duorarum[2]
Ariopsis felis[2]	Haemulon plumierii[2]	Peprilus burti[2]
Astroscopus ygraecum[2]	Haemulon spp.[2]	Peprilus paru[2]
Attached algae[1]	Halichoeres bivittatus[2]	Poecilia latipinna[2]
Bagre marinus[2]	Halodule wrightii[1]	Pogonias cromis[2]
Bairdiella chrysoura[2]	Halophila sp.[1]	Pomatomus saltatrix[2]
Bathygobius soporator[2]	Harengula jaguana[2]	Portunus spp.[2]
Bothidae spp.[2]	Hemicaranx amblyrhynchus[2]	Prionotus scitulus[2]
Brevoortia spp.[2]	Hemiramphus brasiliensis[2]	Prionotus spp.[2]
Calamus arctifrons[2]	Hippocampus erectus[2]	Prionotus tribulus[2]
Calamus penna[2]	Hippocampus zosterae[2]	Pseudocrenilabrinae[2]
Calamus proridens[2]	Hypleurochilus caudovittatus[2]	Rachycentron canadum[2]
Calamus spp.[2]	Hypnea[1]	Rhinoptera bonasus[2]
Callinectes ornatus[2]	Hyporhamphus meeki[2]	Rimapenaeus constrictus[2]
Callinectes sapidus[2]	Hyporhamphus spp.[2]	Sardinella aurita[2]
Callinectes similis[2]	Hyporhamphus unifasciatus[2]	Sarotherodon melanotheron[2]
Callinectes spp.[2]	Hypsoblennius hentz[2]	Sciaenops ocellatus[2]
Caranx bartholomaei[2]	Kyphosus sectatrix[2]	Scomberomorus maculatus[2]
Caranx crysos[2]	Kyphosus spp.[2]	Scorpaena brasiliensis[2]
Caranx hippos[2]	Lachnolaimus maximus[2]	Selene vomer[2]
Caranx latus[2]	Lactophrys trigonus[2]	Serraniculus pumilio[2]
Caranx spp.[2]	Lagodon rhomboides[2]	Serranus subligarius[2]
Carcharhinus limbatus[2]	Leiostomus xanthurus[2]	Sicyonia brevirostris[2]
Caulerpa sertularioides[1]	Limulus polyphemus	Sicyonia laevigata[2]
Centropomus undecimalis[2]	Lobotes surinamensis[2]	Sicyonia spp.[2]
Centropristis striata[2]	Lucania parva[2]	Sicyonia typica[2]
Chaetodipterus faber[2]	Lutjanus analis[2]	Sphoeroides nephelus[2]
Chaetodon capistratus[2]	Lutjanus apodus[2]	Sphoeroides spengleri[2]
Chaetodon ocellatus[2]	Lutjanus griseus[2]	Sphyraena barracuda[2]
Chasmodes saburrae[2]	Lutjanus spp.[2]	Sphyraena borealis[2]
Chelonia mydas[2]	Lutjanus synagris[2]	Sphyraena guachancho[2]
Chilomycterus schoepfii[2]	Lyngbya sp.	Sphyrna tiburo[2]
Chloroscombrus chrysurus[2]	Menidia spp.[2]	Stephanolepis setifer[2]
Citharichthys cornutus[2]	Menippe mercenaria[2]	Strongylura marina[2]
Citharichthys macrops[2]	Menippe spp.[2]	Strongylura notata[2]
Cynoscion arenarius[2]	Menticirrhus americanus[2]	Strongylura timucu[2]

Cynoscion nebulosus[2]	Menticirrhus littoralis[2]	Syacium papillosum[2]
Cyprinodon variegatus[2]	Menticirrhus saxatilis[2]	Symphurus plagiusa[2]
Diapterus auratus[2]	Menticirrhus spp.[2]	Syngnathus floridae[2]
Diodon holocanthus[2]	Microgobius gulosus[2]	Syngnathus louisianae[2]
Diplectrum formosum[2]	Microgobius spp.[2]	Syngnathus scovelli[2]
Diplectrum spp.[2]	Microgobius thalassinus[2]	Syngnathus springeri[2]
Diplodus holbrookii[2]	Micropogonias undulatus[2]	Synodus foetens[2]
Dorosoma petenense[2]	Monacanthus ciliatus[2]	Syringodium filiforme[1]
Drift algae[1]	Mugil cephalus[2]	Thalassia testudinum[1]
Drift red algae[1]	Mugil curema[2]	Trachinotus carolinus[2]
Echeneis naucrates[2]	Mugil spp.[2]	Trachinotus falcatus[2]
Echeneis neucratoides[2]	Mugil trichodon[2]	Trinectes maculatus[2]
Echeneis spp.[2]	Mycteroperca bonaci[2]	Tylosurus crocodilus[2]
Elops saurus[2]	Mycteroperca microlepis[2]	Unidentified species
Engraulidae spp.[2]	Myrophis punctatus[2]	Urophycis floridana[2]
Epinephelus itajara[2]	Narcine bancroftii[2]	Acanthophora sp.[1]
Epinephelus morio[2]	Nicholsina usta[2]	Acanthostracion quadricornis[2]

1 - Submerged Aquatic Vegetation, 2 - Nekton

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1. Florida Department of Environmental Protection (DEP). Florida STORET / WIN. (2024).

2. Florida Fish and Wildlife Conservation Commission (FWC); Florida Fish and Wildlife Research Institute (FWRI). Harmful Algal Bloom Marine Observation Network. (2018).

3. U.S. Environmental Protection Agency (EPA). EPA STOrage and RETrieval Data Warehouse (STORET)/WQX. (2023).

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9. Pinellas County (Florida); Department of Environmental Management; Tampa Bay Estuary Program (TBEP). Western Pinellas County Seagrass Monitoring. (2019).

10. Tampa Bay Interagency Seagrass Monitoring Program; Tampa Bay Estuary Program (TBEP). Tampa Bay Seagrass Monitoring. (2023).