

Cape Haze Aquatic Preserve

SEACAR Habitat Analyses

Last compiled on 22 May, 2025

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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 determination; 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

<i>Qualifier Source</i>	<i>Value Qualifier</i>	<i>Include</i>	<i>Description</i>
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 $p \geq 0.05$). 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

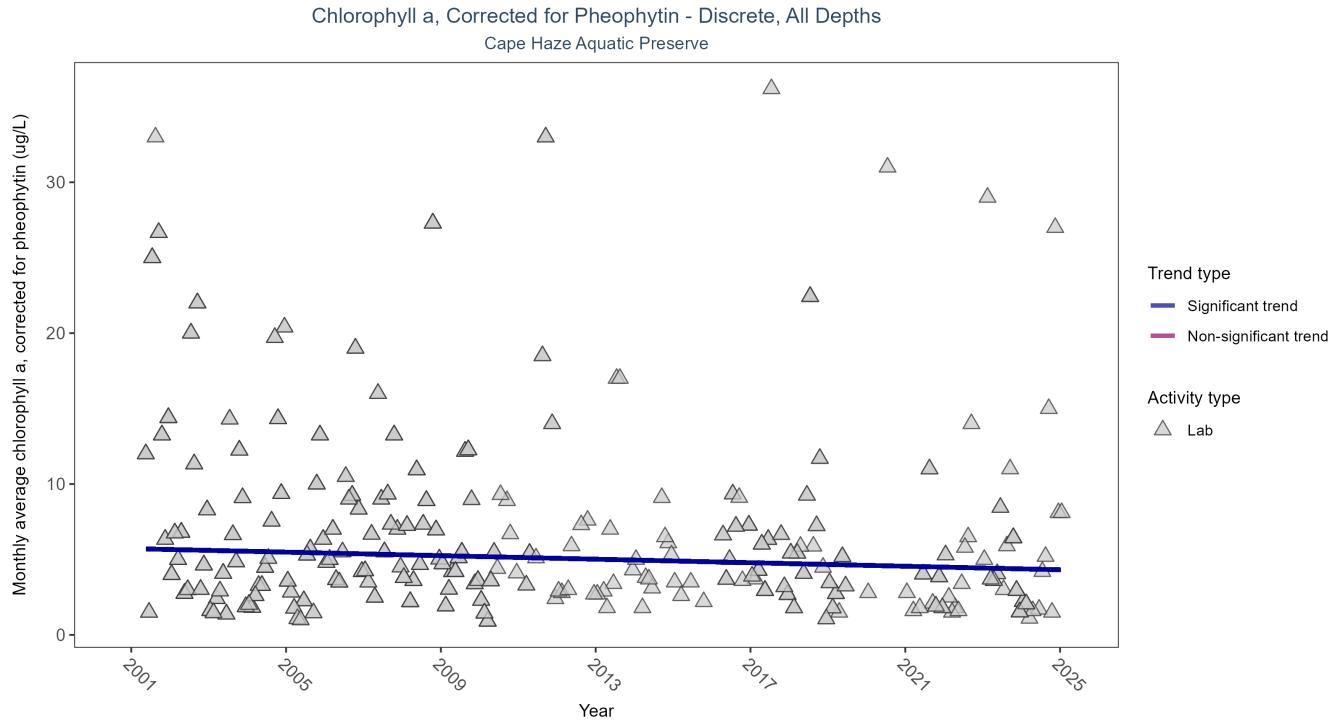


Figure 1: Scatter plot of monthly average levels of chlorophyll a, corrected for pheophytin, over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed chlorophyll a (triangles) 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	603	25	2001 - 2025	4.2	-0.1285	5.7193	-0.0584	0.0136

Monthly average chlorophyll a, corrected for pheophytin, decreased by 0.06 µg/L per year, indicating an increase in water clarity.

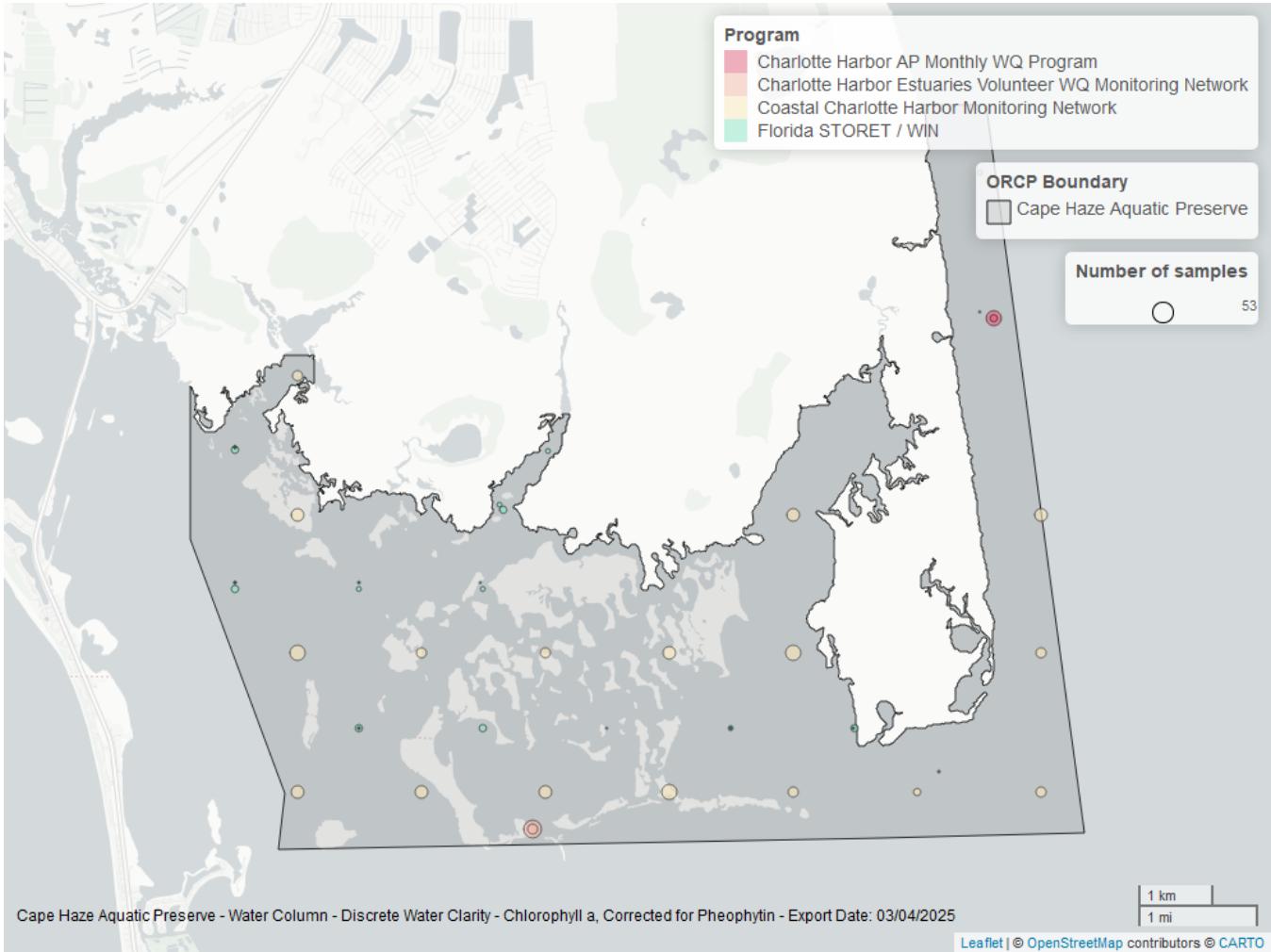


Figure 2: Map showing location of discrete water quality sampling locations within the boundaries of *Cape Haze Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

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

ProgramID	N_Data	YearMin	YearMax
513	383	2001	2021
5002	109	2011	2024
476	70	2008	2023
5028	44	2021	2025

Program names:

476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network¹

513 - Coastal Charlotte Harbor Monitoring Network²

5002 - Florida STORET / WIN³

5028 - Charlotte Harbor Aquatic Preserves Monthly Water Quality Program⁴

Chlorophyll a, Uncorrected for Pheophytin - Discrete Seasonal Kendall-Tau Trend Analysis

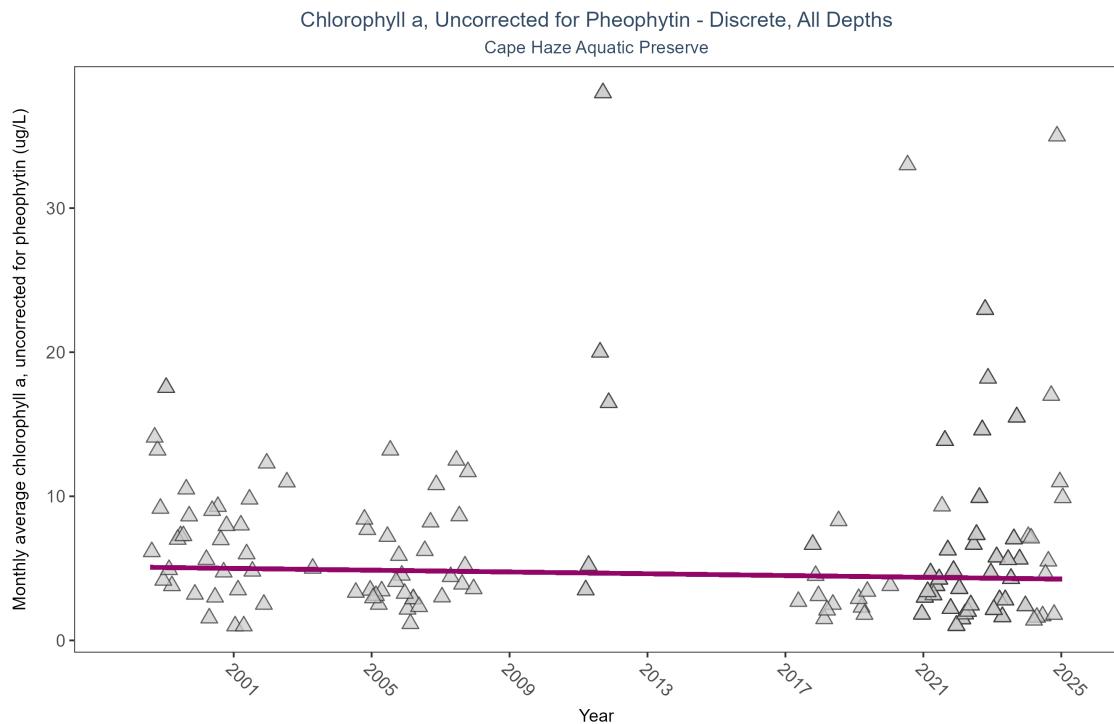


Figure 3: Scatter plot of monthly average levels of chlorophyll a, uncorrected for pheophytin, over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed chlorophyll a (triangles) 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	No significant trend	308	20	1998 - 2025	4.05	-0.0701	5.0884	-0.0309	0.3391

Chlorophyll a, uncorrected for pheophytin, showed no detectable trend between 1998 and 2025.

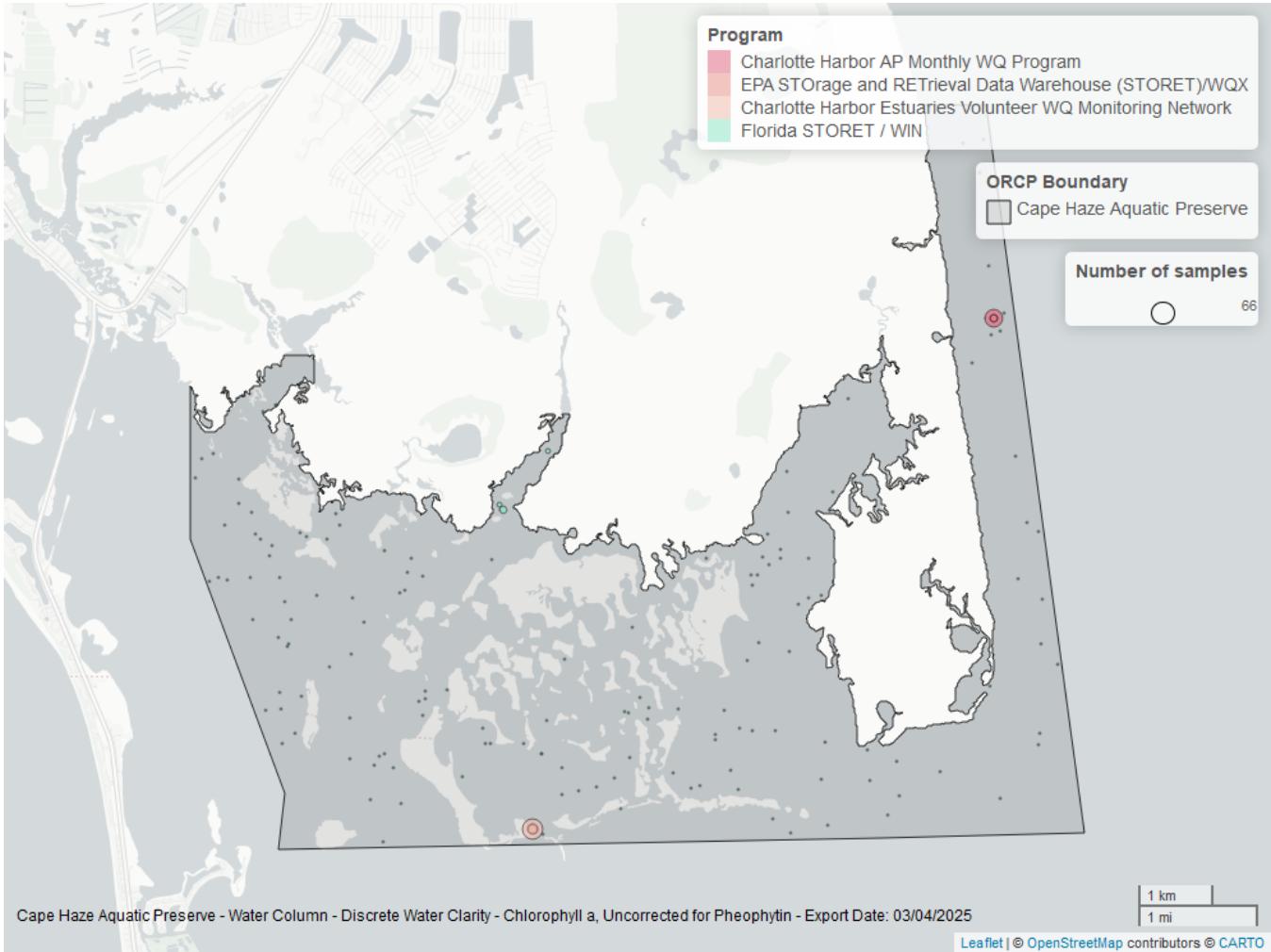


Figure 4: Map showing location of discrete water quality sampling locations within the boundaries of *Cape Haze Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

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

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
5002	165	2011	2023
476	85	1998	2023
5028	54	2021	2025
103	20	2002	2022

Program names:

- 103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX⁵
- 476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network¹
- 5002 - Florida STORET / WIN³
- 5028 - Charlotte Harbor Aquatic Preserves Monthly Water Quality Program⁴

Dissolved Oxygen - Discrete

Seasonal Kendall-Tau Trend Analysis

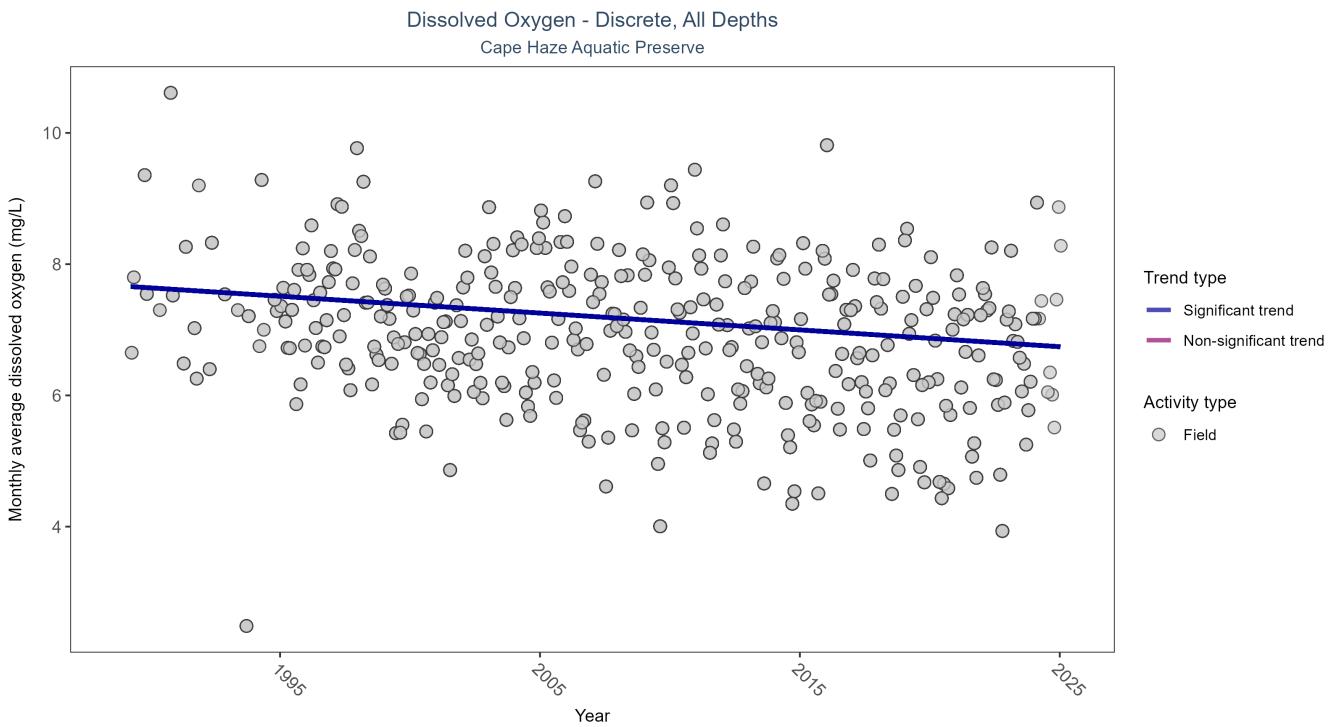


Figure 5: Scatter plot of monthly average dissolved oxygen over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only dissolved oxygen values measured in the field (circles) are included in the plot.

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	Significantly decreasing trend	11470	37	1989 - 2025	6.8	-0.2189	7.6648	-0.0256	0

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

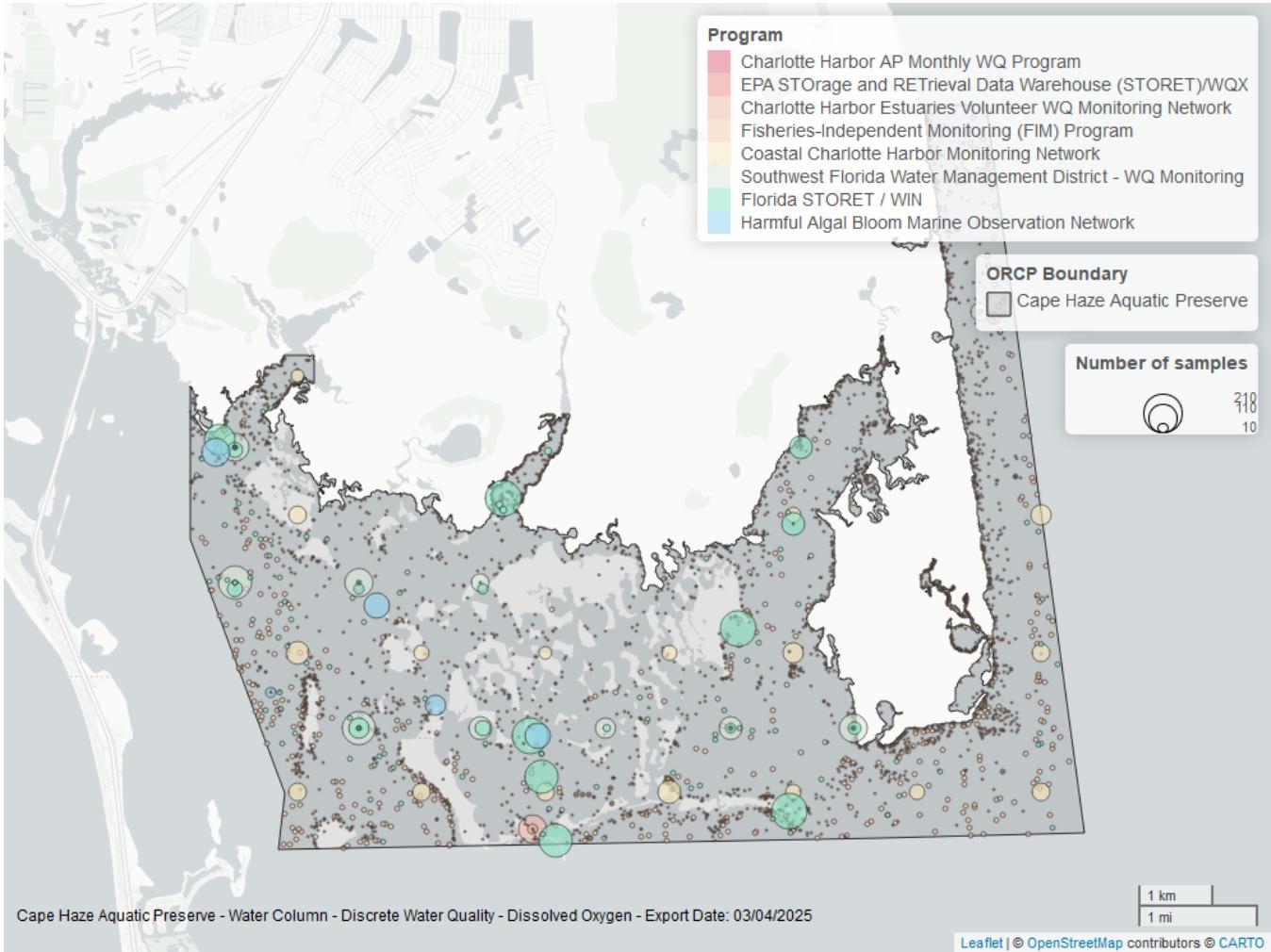


Figure 6: Map showing location of discrete water quality sampling locations within the boundaries of *Cape Haze Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 11: Programs contributing data for Dissolved Oxygen

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
69	6769	1989	2022
5002	2204	1995	2024
479	1109	2001	2016
513	816	2001	2010
95	422	1998	2018
476	139	1998	2023
5028	21	2022	2025
103	15	2020	2022

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program⁶

95 - Harmful Algal Bloom Marine Observation Network⁷

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX⁵

476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network¹

479 - Southwest Florida Water Management District - Water Quality Monitoring⁸

513 - Coastal Charlotte Harbor Monitoring Network²

5002 - Florida STORET / WIN³

5028 - Charlotte Harbor Aquatic Preserves Monthly Water Quality Program⁴

pH - Discrete

Seasonal Kendall-Tau Trend Analysis

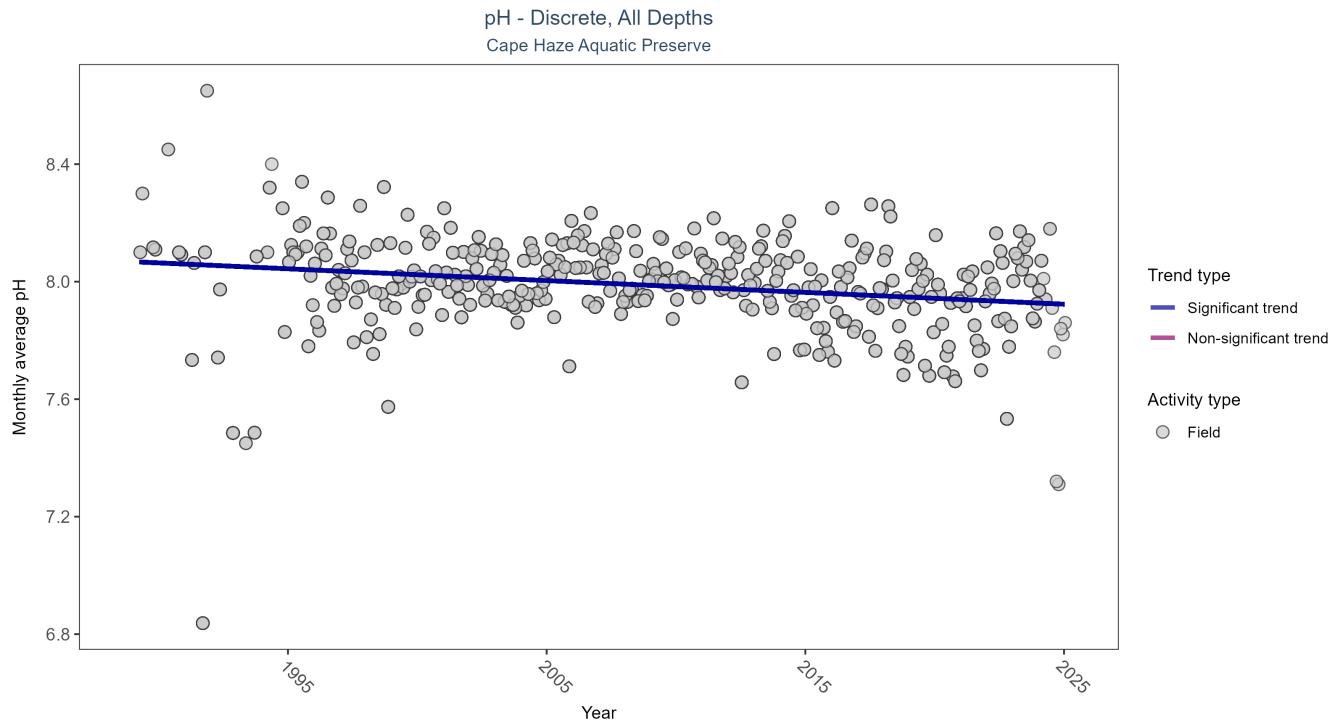


Figure 7: Scatter plot of monthly average pH over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only pH values measured in the field (circles) are included in the plot.

Table 12: 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	11065	37	1989 - 2025	8	-0.1854	8.0679	-0.004	0

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

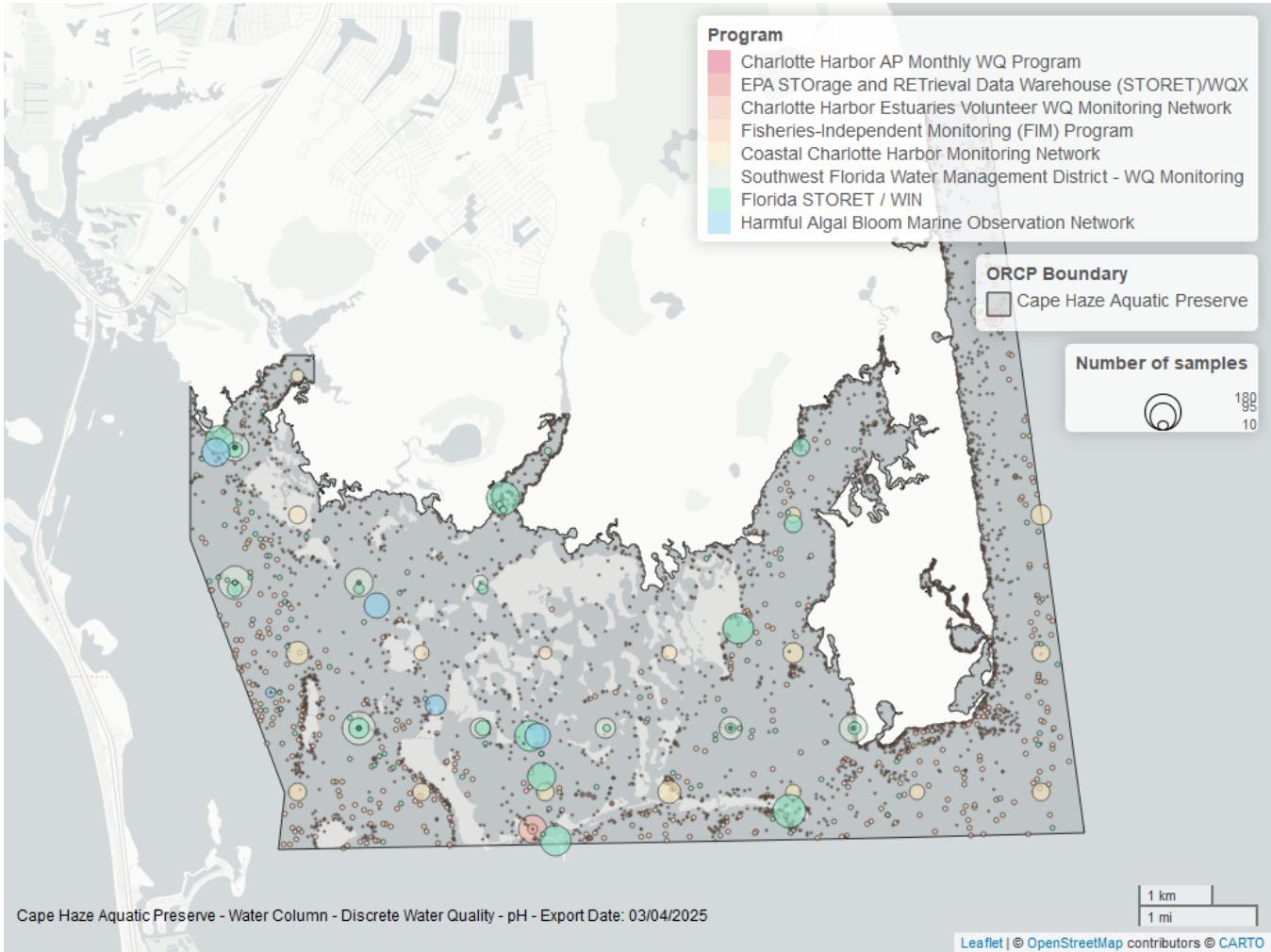


Figure 8: Map showing location of discrete water quality sampling locations within the boundaries of *Cape Haze Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 13: Programs contributing data for pH

ProgramID	N_Data	YearMin	YearMax
69	6714	1989	2022
5002	1822	1995	2024
479	1095	2001	2016
513	815	2001	2010
95	421	2008	2018
476	144	1998	2023
5028	43	2021	2025
103	20	2020	2022

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program⁶

95 - Harmful Algal Bloom Marine Observation Network⁷

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX⁵

476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network¹

479 - Southwest Florida Water Management District - Water Quality Monitoring⁸

513 - Coastal Charlotte Harbor Monitoring Network²

5002 - Florida STORET / WIN³

5028 - Charlotte Harbor Aquatic Preserves Monthly Water Quality Program⁴

Salinity - Discrete

Seasonal Kendall-Tau Trend Analysis

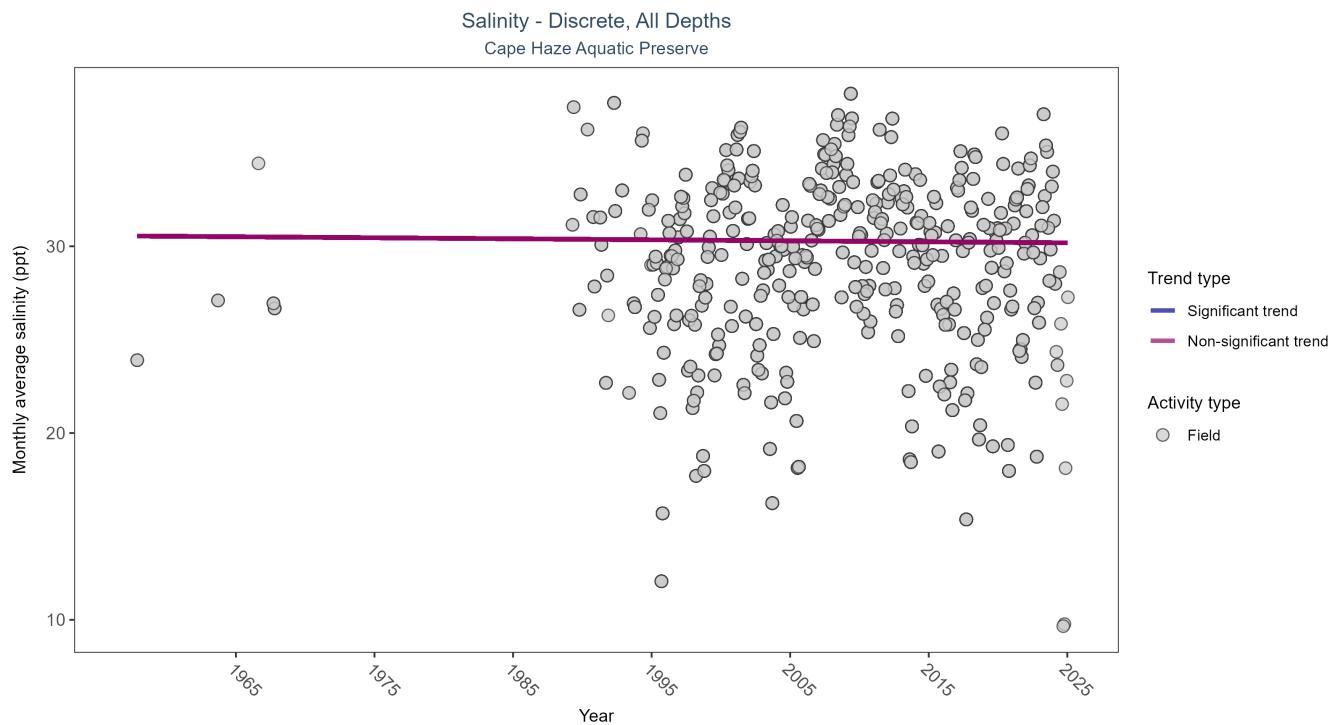


Figure 9: Scatter plot of monthly average salinity over time. If the time series included ten or more years of discrete observations, significant (blue) or non-significant (magenta) trend lines are also shown. Discrete salinity values derived from grab samples analyzed in the field (circles) or the laboratory (triangles) are both included in the plot.

Table 14: 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	11803	41	1957 - 2025	30.16	-0.0104	30.5529	-0.0054	0.767

Salinity showed no detectable trend between 1957 and 2025.

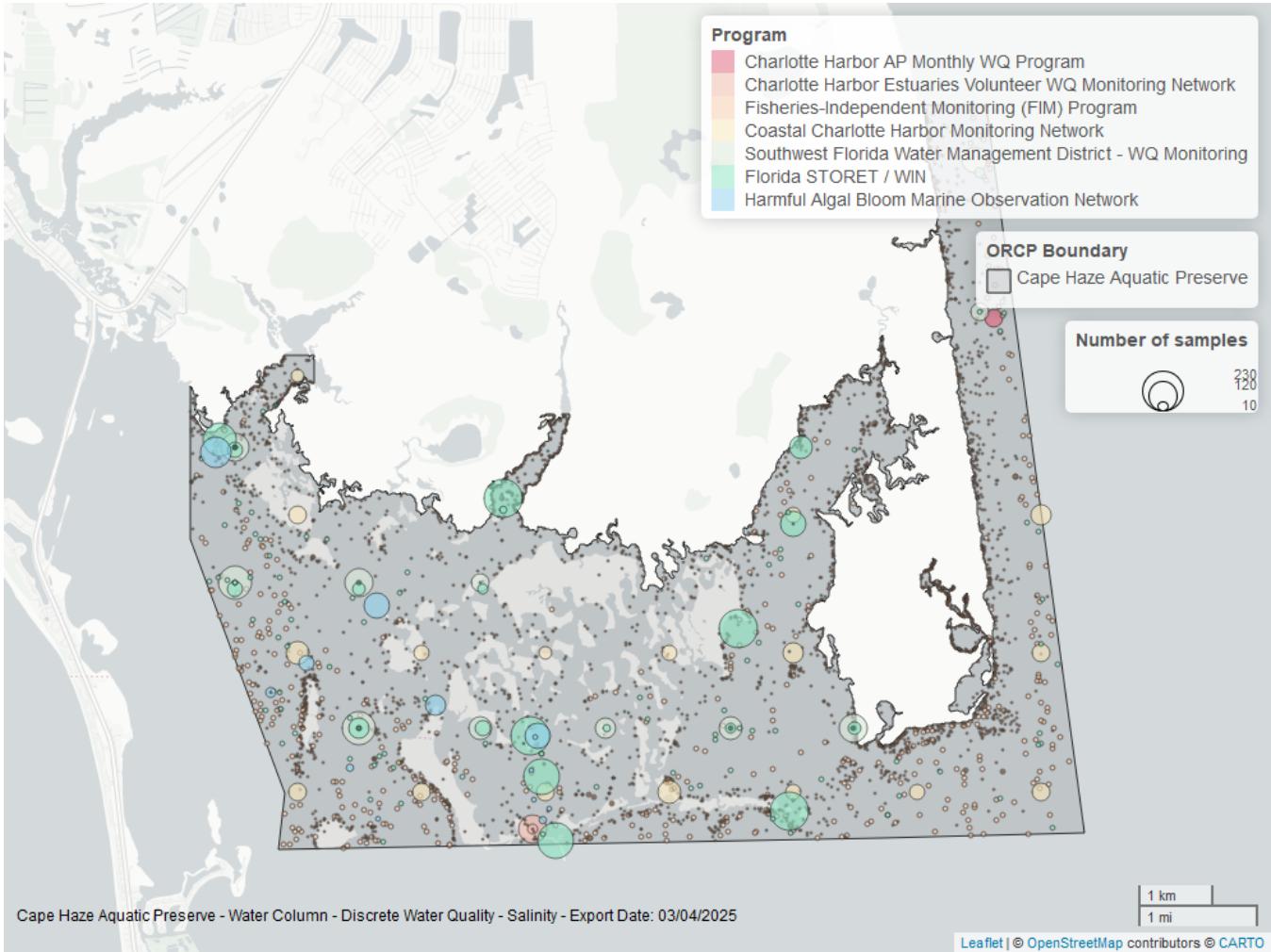


Figure 10: Map showing location of discrete water quality sampling locations within the boundaries of *Cape Haze Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 15: Programs contributing data for Salinity

ProgramID	N_Data	YearMin	YearMax
69	6839	1989	2022
5002	2344	1995	2024
479	1098	2001	2016
513	817	2001	2010
95	519	1957	2018
476	145	1998	2023
5028	43	2021	2025

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program⁶

95 - Harmful Algal Bloom Marine Observation Network⁷

476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network¹

479 - Southwest Florida Water Management District - Water Quality Monitoring⁸

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5002 - Florida STORET / WIN³

5028 - Charlotte Harbor Aquatic Preserves Monthly Water Quality Program⁴

Secchi Depth - Discrete

Seasonal Kendall-Tau Trend Analysis

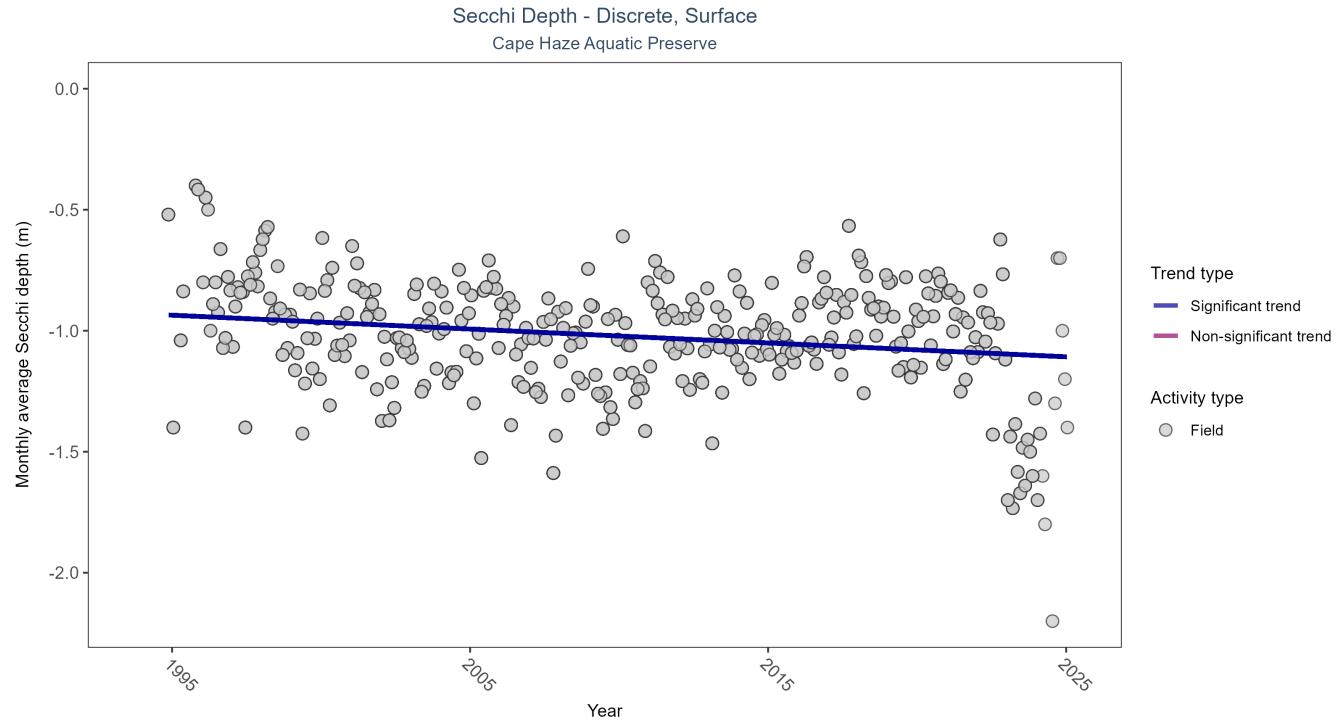


Figure 11: Scatter plot of monthly average Secchi depth over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Secchi depth is only measured in the field (circles).

Table 16: 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	7987	32	1994 - 2025	-0.9	-0.1489	-0.93	-0.0057	0.0001

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

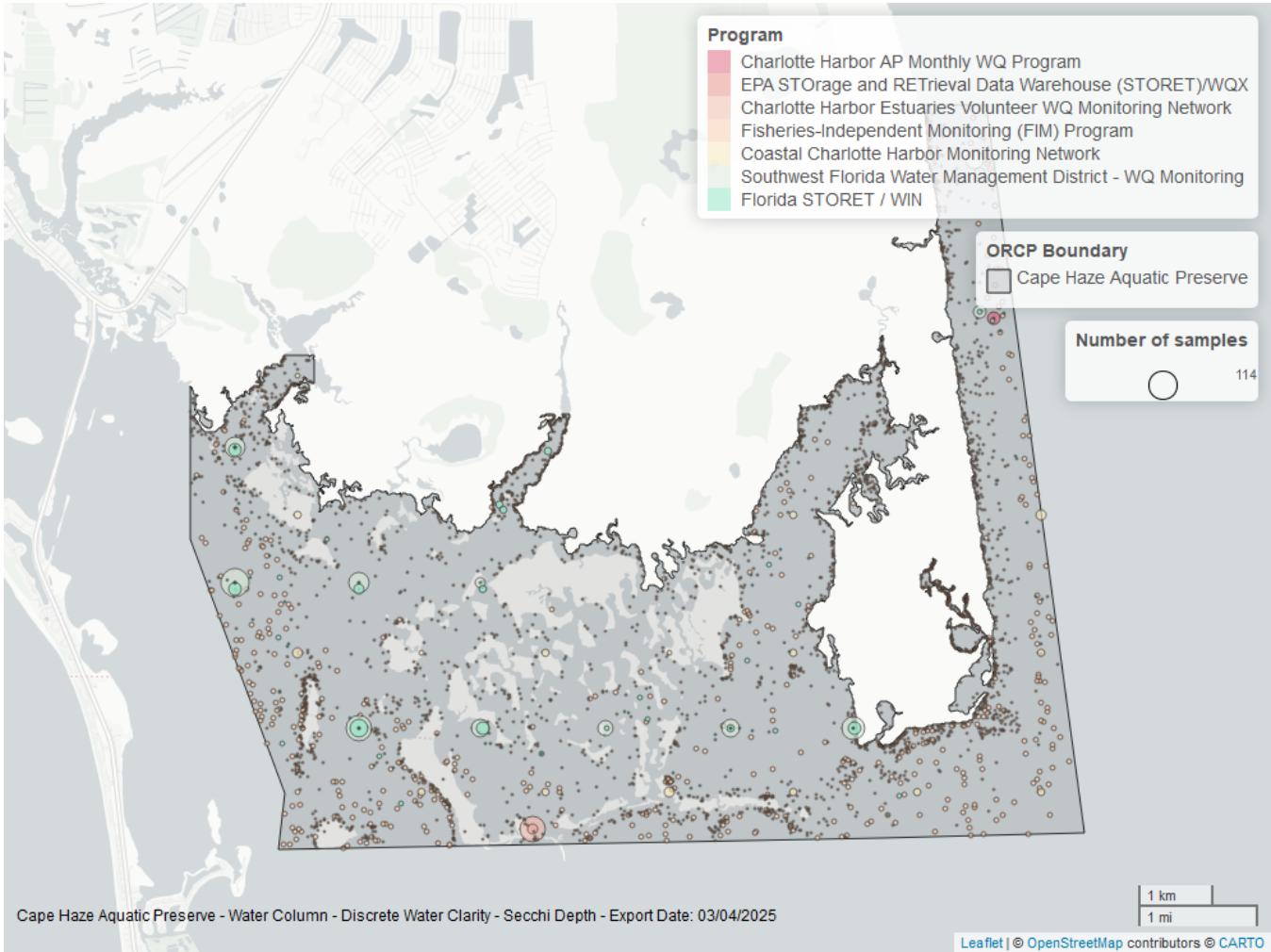


Figure 12: Map showing location of discrete water quality sampling locations within the boundaries of *Cape Haze Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 17: Programs contributing data for Secchi Depth

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
69	6580	1994	2022
479	655	2001	2016
5002	438	2008	2024
513	161	2001	2010
476	125	1998	2023
5028	21	2022	2025
103	8	2020	2022

Program names:

- 69 - Fisheries-Independent Monitoring (FIM) Program⁶
- 103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX⁵
- 476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network¹
- 479 - Southwest Florida Water Management District - Water Quality Monitoring⁸
- 513 - Coastal Charlotte Harbor Monitoring Network²

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) $TN = TKN + NO_3O_2;$
- 2) $TN = TKN + NO_3 + NO_2;$
- 3) $TN = ORGN + NH_4 + NO_3O_2;$
- 4) $TN = ORGN + NH_4 + NO_2 + NO_3;$
- 5) $TN = TKN + NO_3;$
- 6) $TN = ORGN + NH_4 + NO_3;$

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

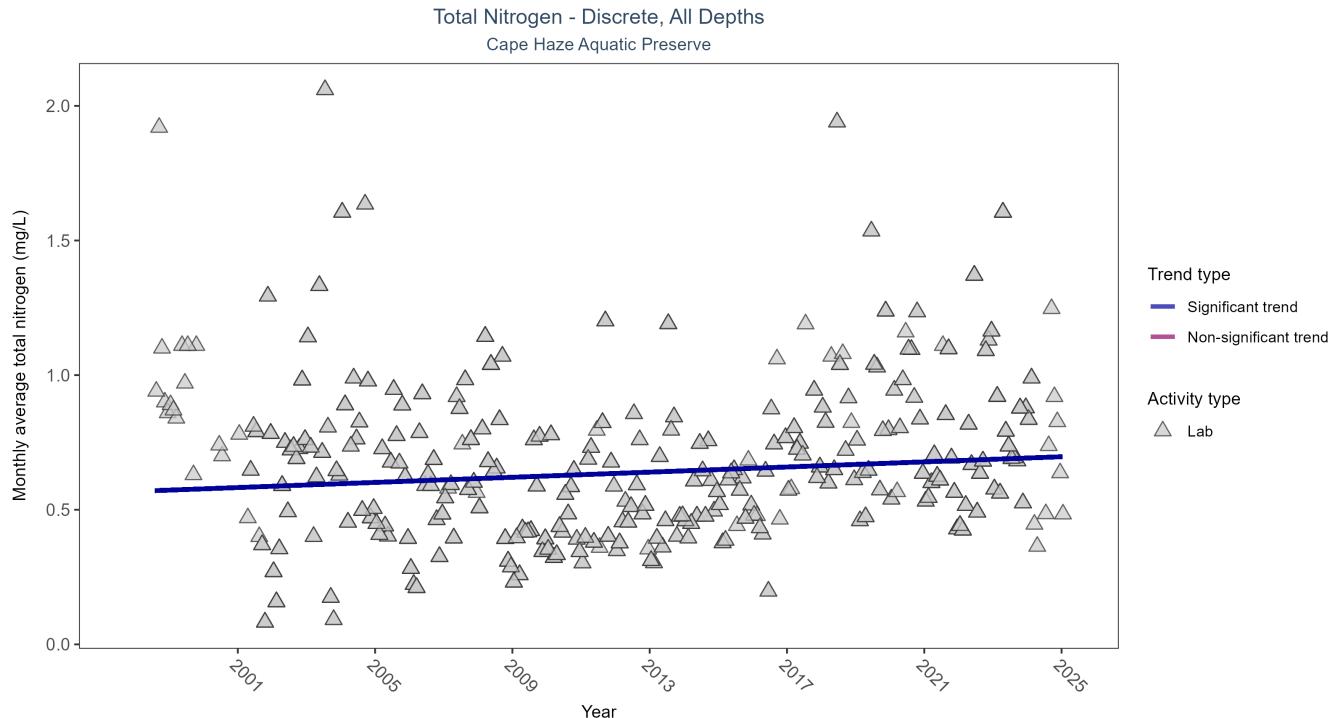


Figure 13: Scatter plot of monthly average total nitrogen over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only nitrogen values obtained from laboratory analyses (triangles) are included in the plot.

Table 18: 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	1080	28	1998 - 2025	0.605	0.0944	0.5681	0.0048	0.0237

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

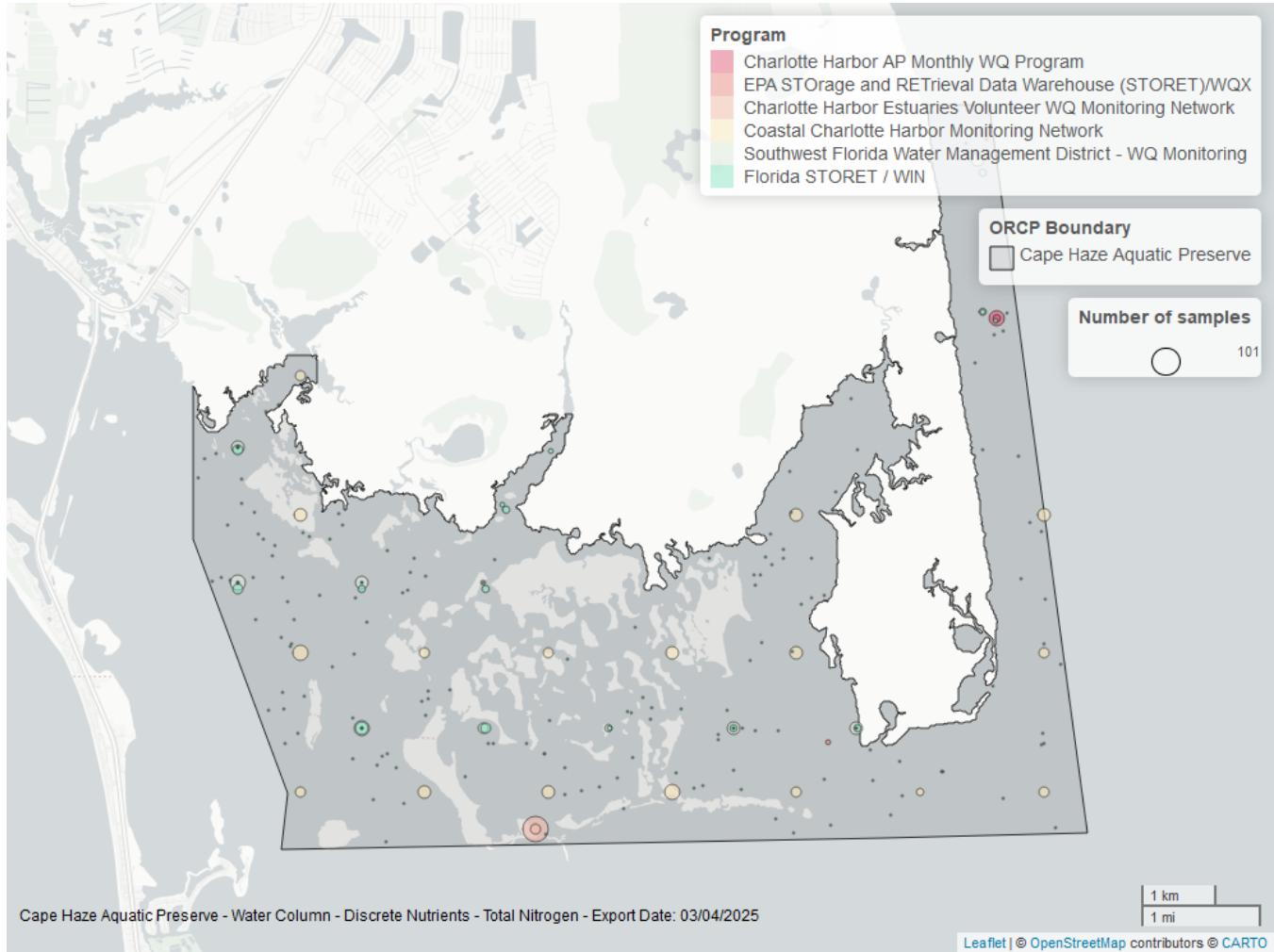


Figure 14: Map showing location of discrete water quality sampling locations within the boundaries of *Cape Haze Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 19: Programs contributing data for Total Nitrogen

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
513	378	2001	2021
5002	303	2006	2024
479	244	2007	2016
476	117	1998	2023
5028	42	2021	2025
103	3	2002	2002

Program names:

- 103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX⁵
- 476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network¹
- 479 - Southwest Florida Water Management District - Water Quality Monitoring⁸
- 513 - Coastal Charlotte Harbor Monitoring Network²
- 5002 - Florida STORET / WIN³
- 5028 - Charlotte Harbor Aquatic Preserves Monthly Water Quality Program⁴

Total Phosphorus - Discrete

Seasonal Kendall-Tau Trend Analysis

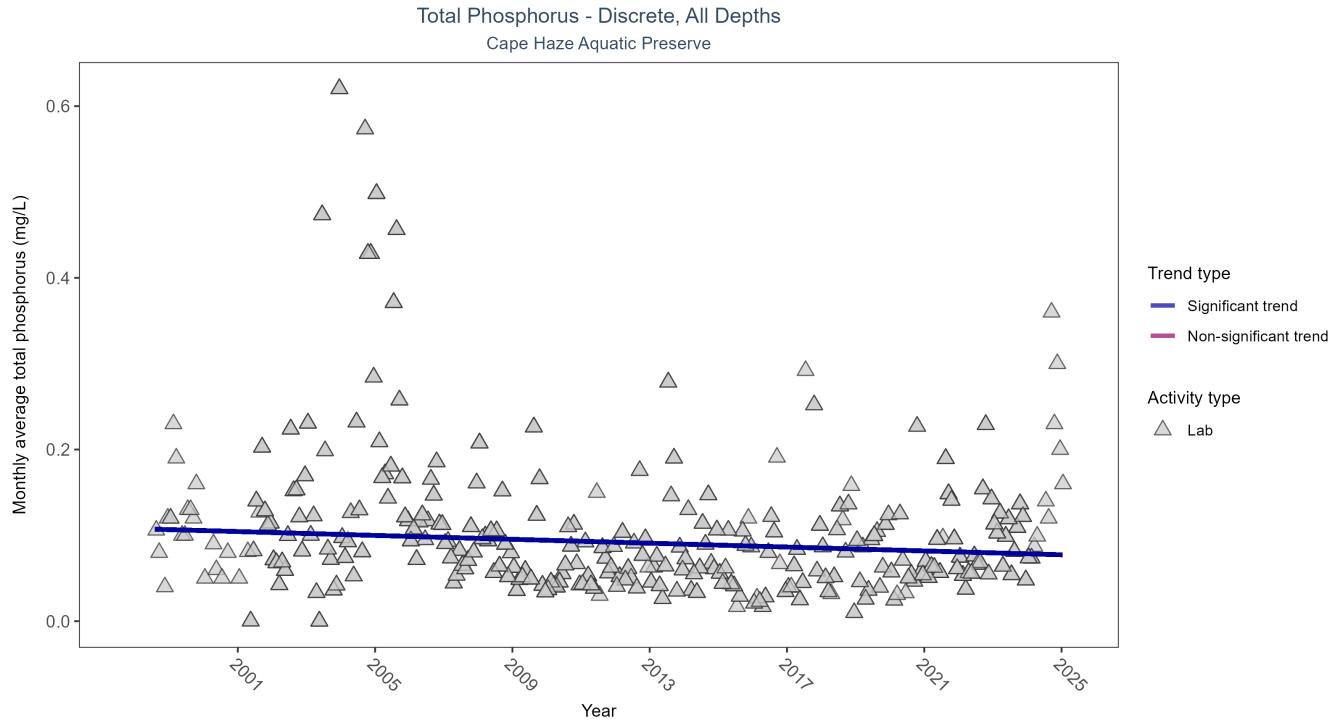


Figure 15: Scatter plot of monthly average total phosphorus over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only phosphorus values obtained from laboratory analyses (triangles) are included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

Table 20: 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	1113	28	1998 - 2025	0.076	-0.114	0.1078	-0.0011	0.0066

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

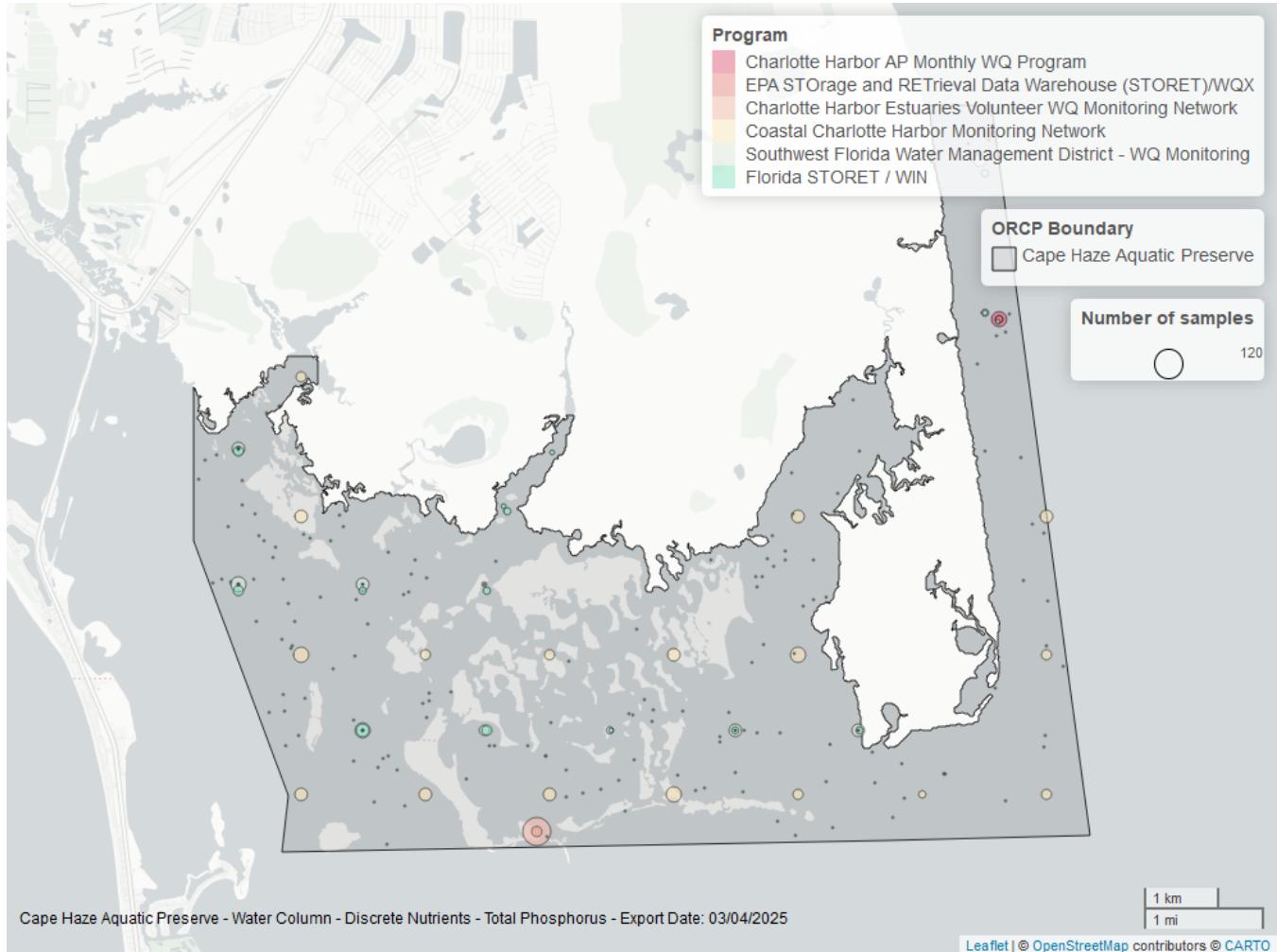


Figure 16: Map showing location of discrete water quality sampling locations within the boundaries of *Cape Haze Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 21: Programs contributing data for Total Phosphorus

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
513	384	2001	2021
5002	300	2008	2024
479	243	2007	2016
476	137	1998	2023
5028	44	2021	2025
103	17	2002	2022

Program names:

- 103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX⁵
- 476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network¹
- 479 - Southwest Florida Water Management District - Water Quality Monitoring⁸
- 513 - Coastal Charlotte Harbor Monitoring Network²
- 5002 - Florida STORET / WIN³
- 5028 - Charlotte Harbor Aquatic Preserves Monthly Water Quality Program⁴

Total Suspended Solids - Discrete

Seasonal Kendall-Tau Trend Analysis

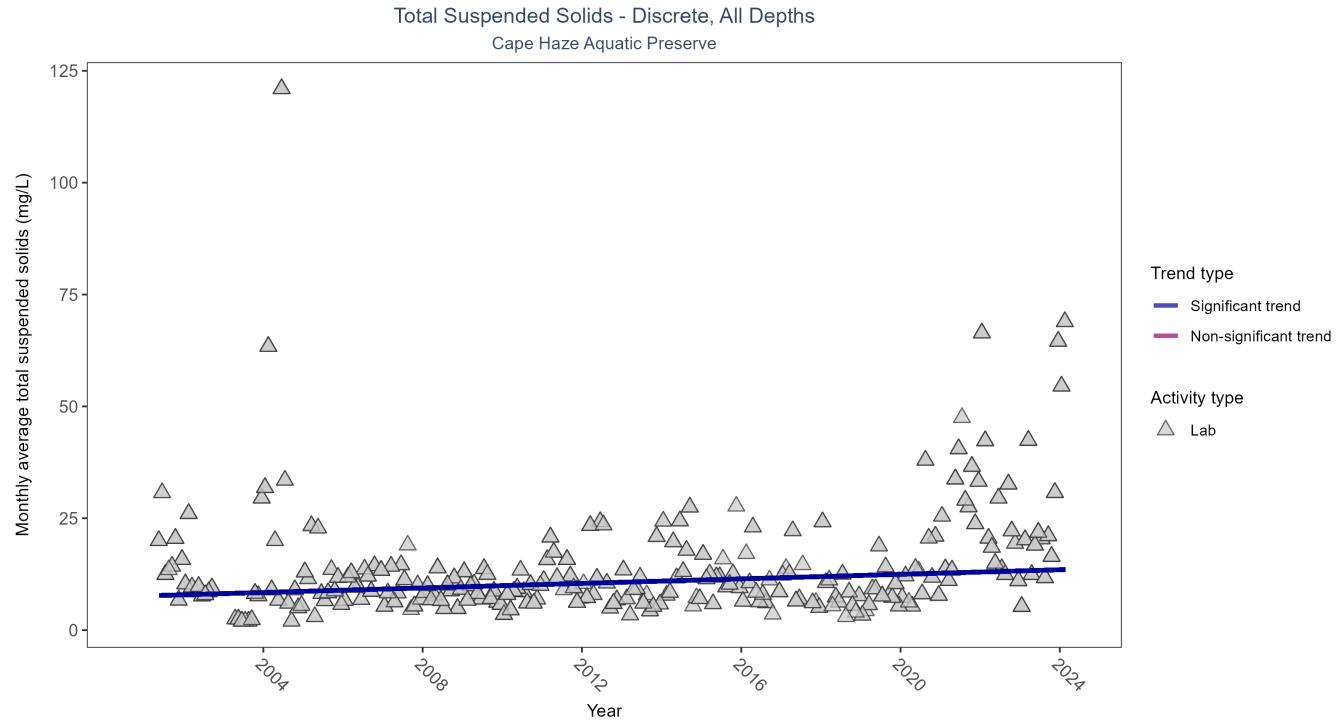


Figure 17: Scatter plot of monthly average total suspended solids (TSS) over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only TSS values obtained from laboratory analyses (triangles) are included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

Table 22: 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 increasing trend	882	24	2001 - 2024	9.69	0.1735	7.6425	0.2542	0.0001

Monthly average total suspended solids increased by 0.25 mg/L per year, indicating a decrease in water clarity.

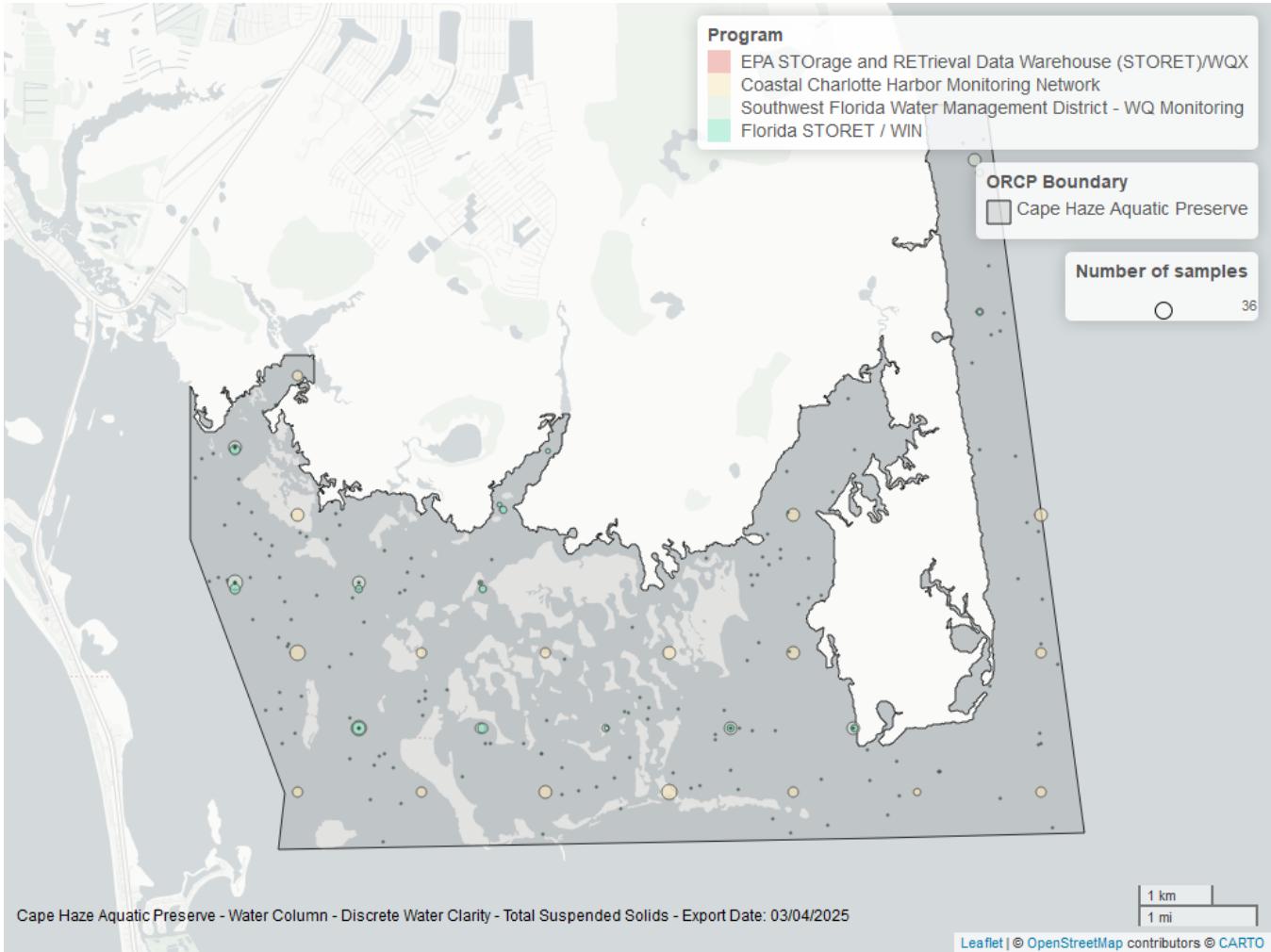


Figure 18: Map showing location of discrete water quality sampling locations within the boundaries of *Cape Haze Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 23: Programs contributing data for Total Suspended Solids

ProgramID	N_Data	YearMin	YearMax
513	360	2001	2021
5002	299	2006	2024
479	243	2007	2016
103	4	2020	2020

Program names:

- 103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX⁵
- 479 - Southwest Florida Water Management District - Water Quality Monitoring⁸
- 513 - Coastal Charlotte Harbor Monitoring Network²
- 5002 - Florida STORET / WIN³

Turbidity - Discrete

Seasonal Kendall-Tau Trend Analysis

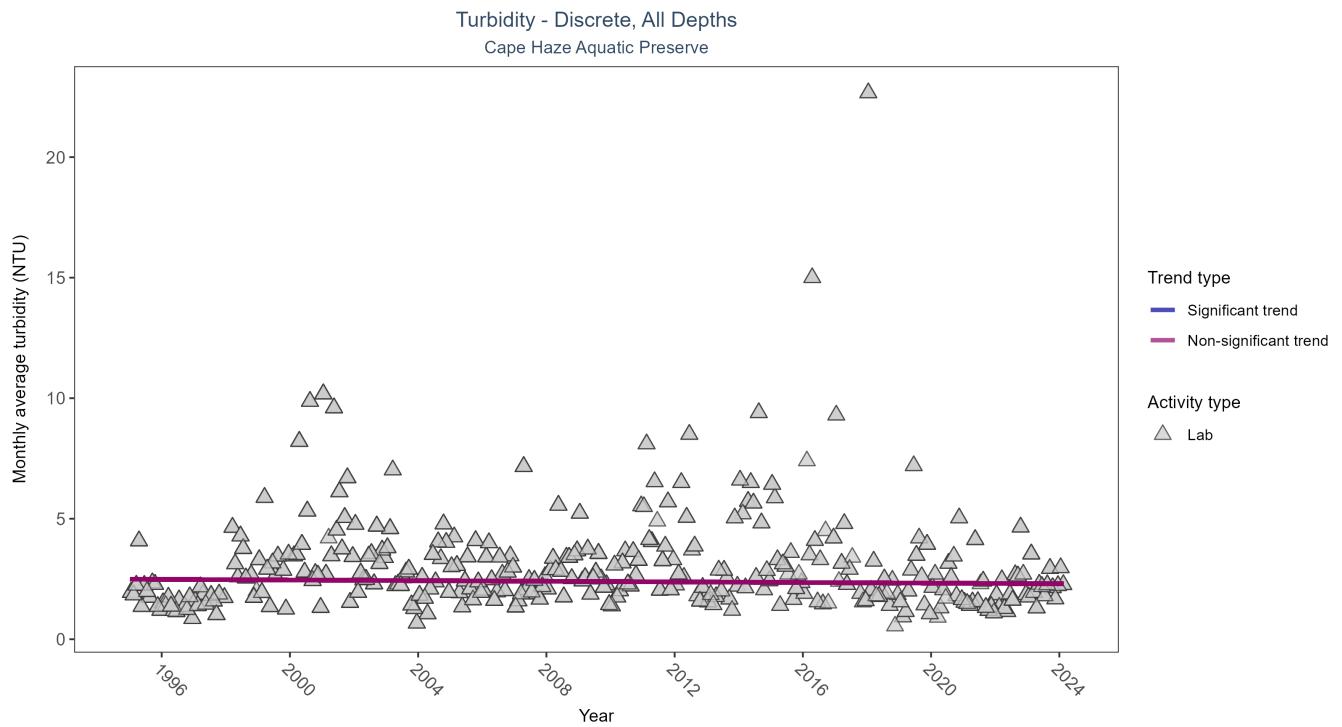


Figure 19: Scatter plot of monthly average turbidity over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only turbidity values measured in the laboratory (triangles) are included in the plot.

Table 24: 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	No significant trend	2375	30	1995 - 2024	2.2	-0.0337	2.4898	-0.0065	0.356

Turbidity showed no detectable trend between 1995 and 2024.

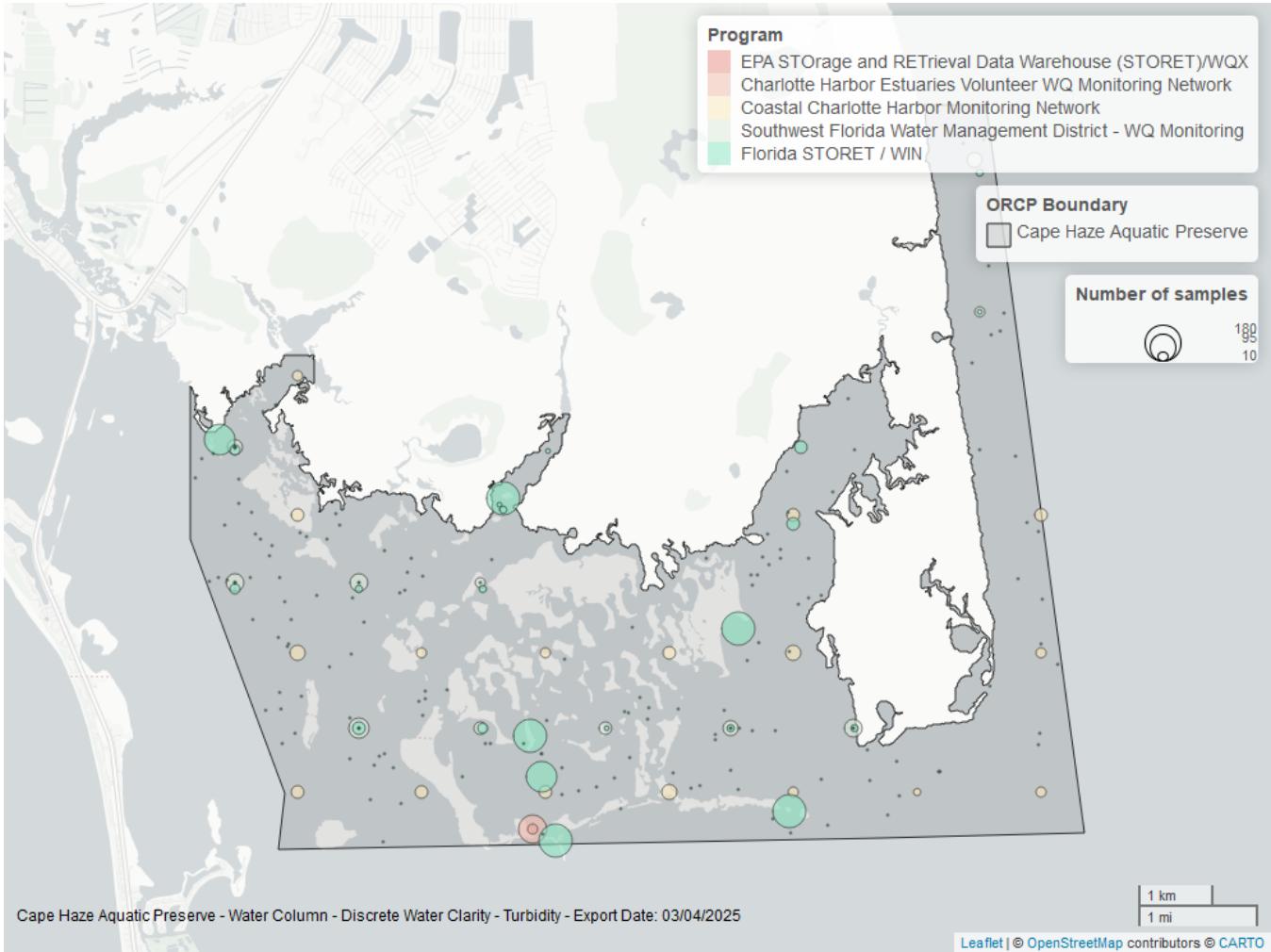


Figure 20: Map showing location of discrete water quality sampling locations within the boundaries of *Cape Haze Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 25: Programs contributing data for Turbidity

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
5002	1470	1995	2024
513	384	2001	2021
479	383	2001	2016
476	147	1998	2023
103	8	2020	2021

Program names:

- 103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX⁵
- 476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network¹
- 479 - Southwest Florida Water Management District - Water Quality Monitoring⁸
- 513 - Coastal Charlotte Harbor Monitoring Network²
- 5002 - Florida STORET / WIN³

Water Temperature - Discrete Seasonal Kendall-Tau Trend Analysis

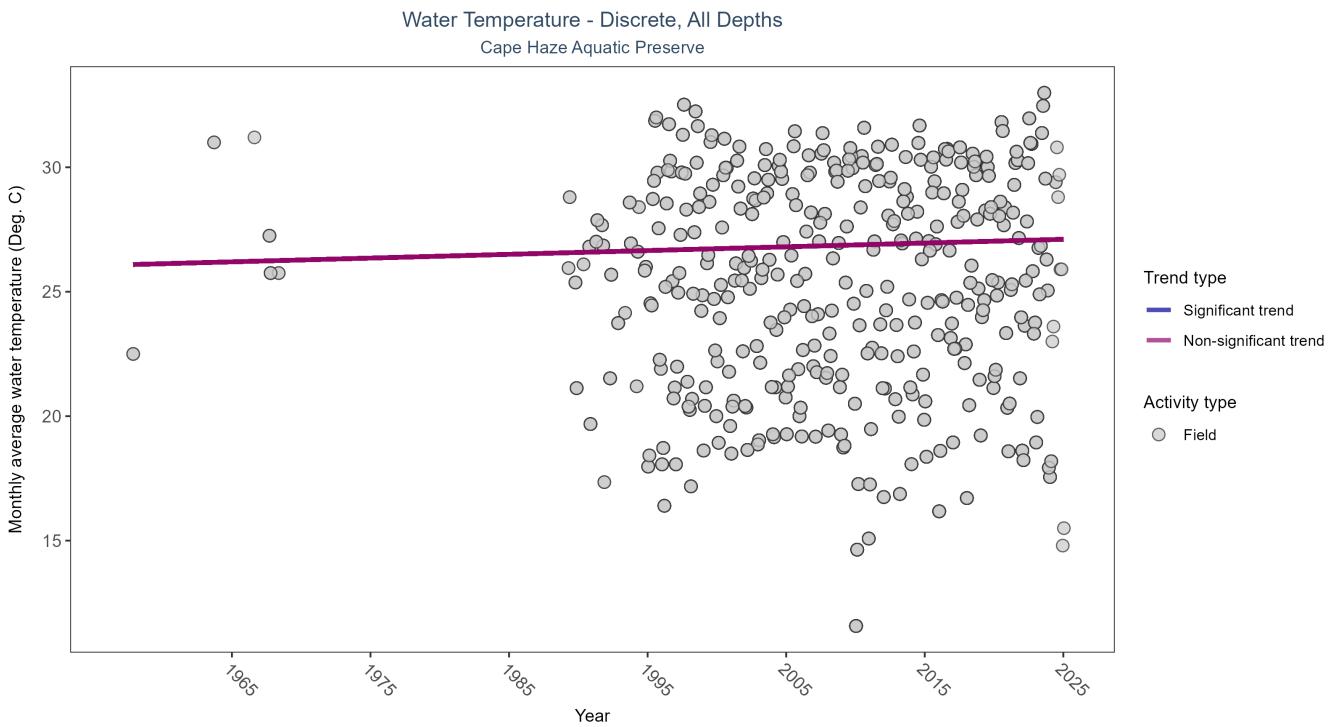


Figure 21: Scatter plot of monthly average water temperature over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only water temperature measurements taken in the field (circles) are included in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

Table 26: 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	No significant trend	11817	42	1957 - 2025	26.83	0.0634	26.0796	0.0151	0.0588

Water temperature showed no detectable trend between 1957 and 2025.

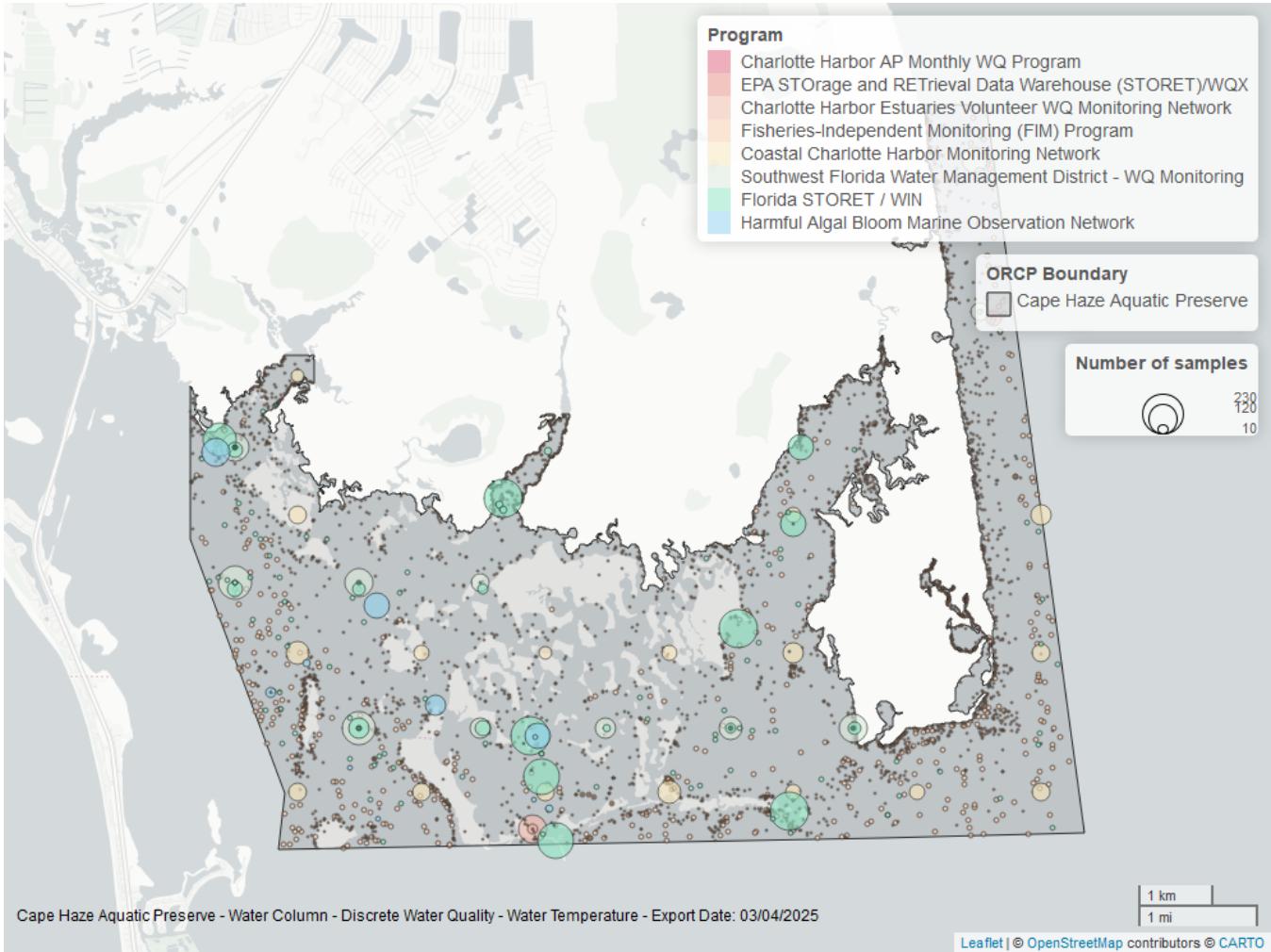


Figure 22: Map showing location of discrete water quality sampling locations within the boundaries of *Cape Haze Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 27: Programs contributing data for Water Temperature

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
69	6842	1989	2022
5002	2365	1995	2024
479	1111	2001	2016
513	817	2001	2010
95	481	1957	2018
476	147	1998	2023
5028	36	2021	2025
103	19	2020	2022

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program⁶

95 - Harmful Algal Bloom Marine Observation Network⁷

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX⁵

476 - Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network¹

479 - Southwest Florida Water Management District - Water Quality Monitoring⁸

513 - Coastal Charlotte Harbor Monitoring Network²

5002 - Florida STORET / WIN³

5028 - Charlotte Harbor Aquatic Preserves Monthly Water Quality Program⁴

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 Cape Haze Aquatic Preserve

Table 28: Station overview for Continuous parameters by Program

<i>ProgramID</i>	<i>ProgramLocationID</i>	<i>Years of Data</i>	<i>Use in Analysis</i>	<i>Parameters</i>
512	CHWW1	4	FALSE	DO , DOS , pH , Sal , Turb , TempW

Program names:

512 - Charlotte Harbor Aquatic Preserves Continuous Water Quality Monitoring⁹

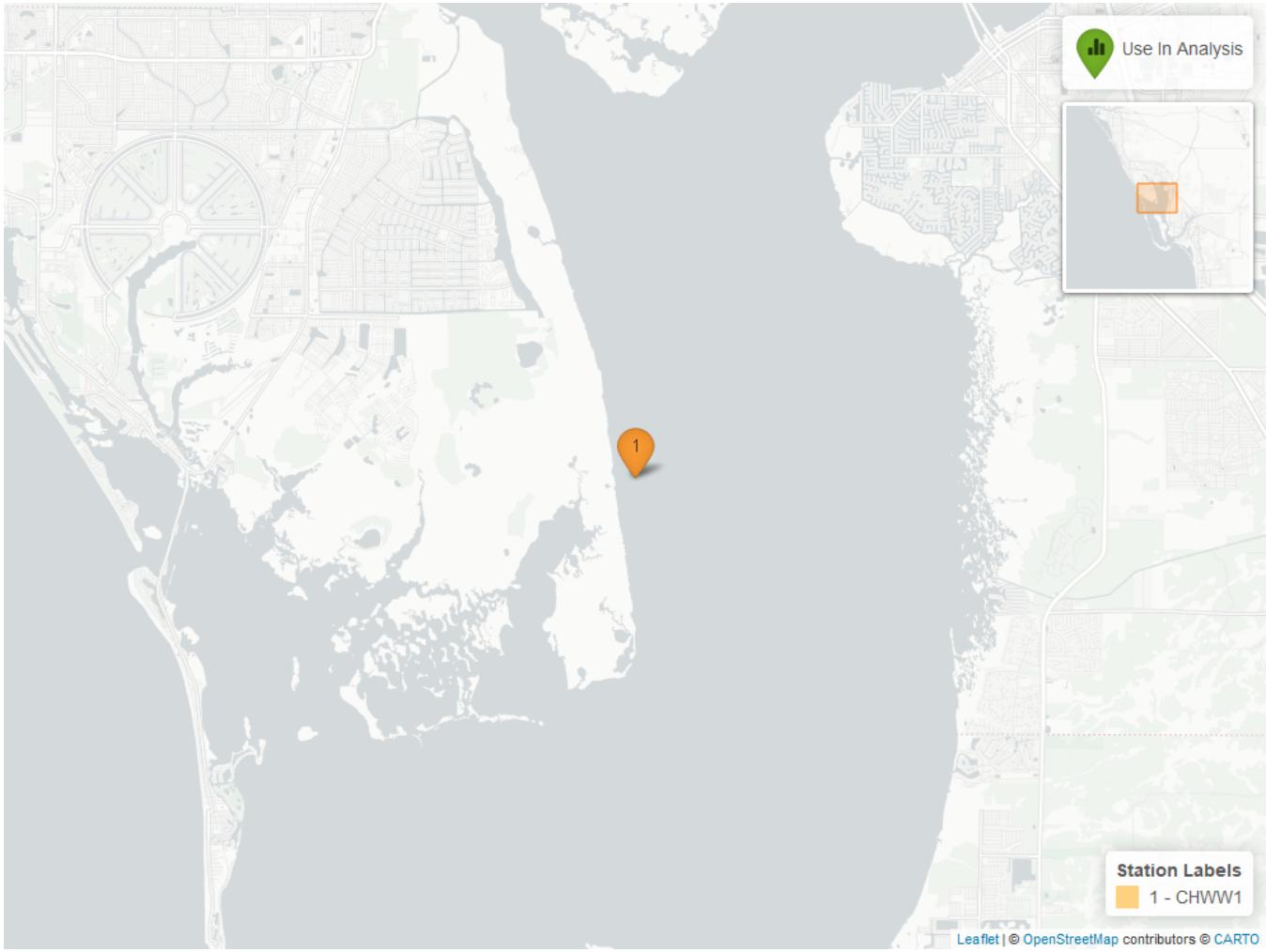


Figure 23: Map showing continuous water quality sampling locations within the boundaries of *Cape Haze Aquatic Preserve*. Sites marked as *Use In Analysis* (green) are featured in this report.

Dissolved Oxygen - Continuous

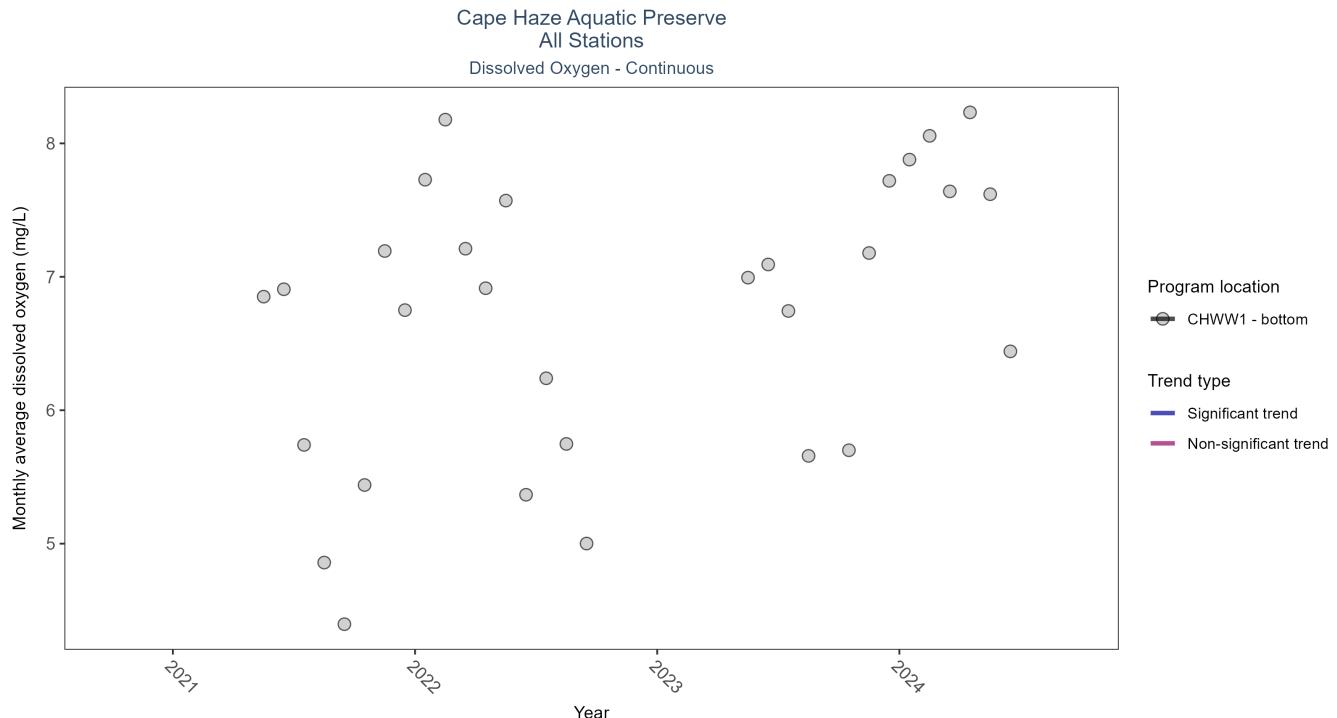


Figure 24: Scatter plot of monthly average dissolved oxygen over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 29: 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
CHWW1	Insufficient data to calculate trend	73578	4	2021 - 2024	6.9	-	-	-	-

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

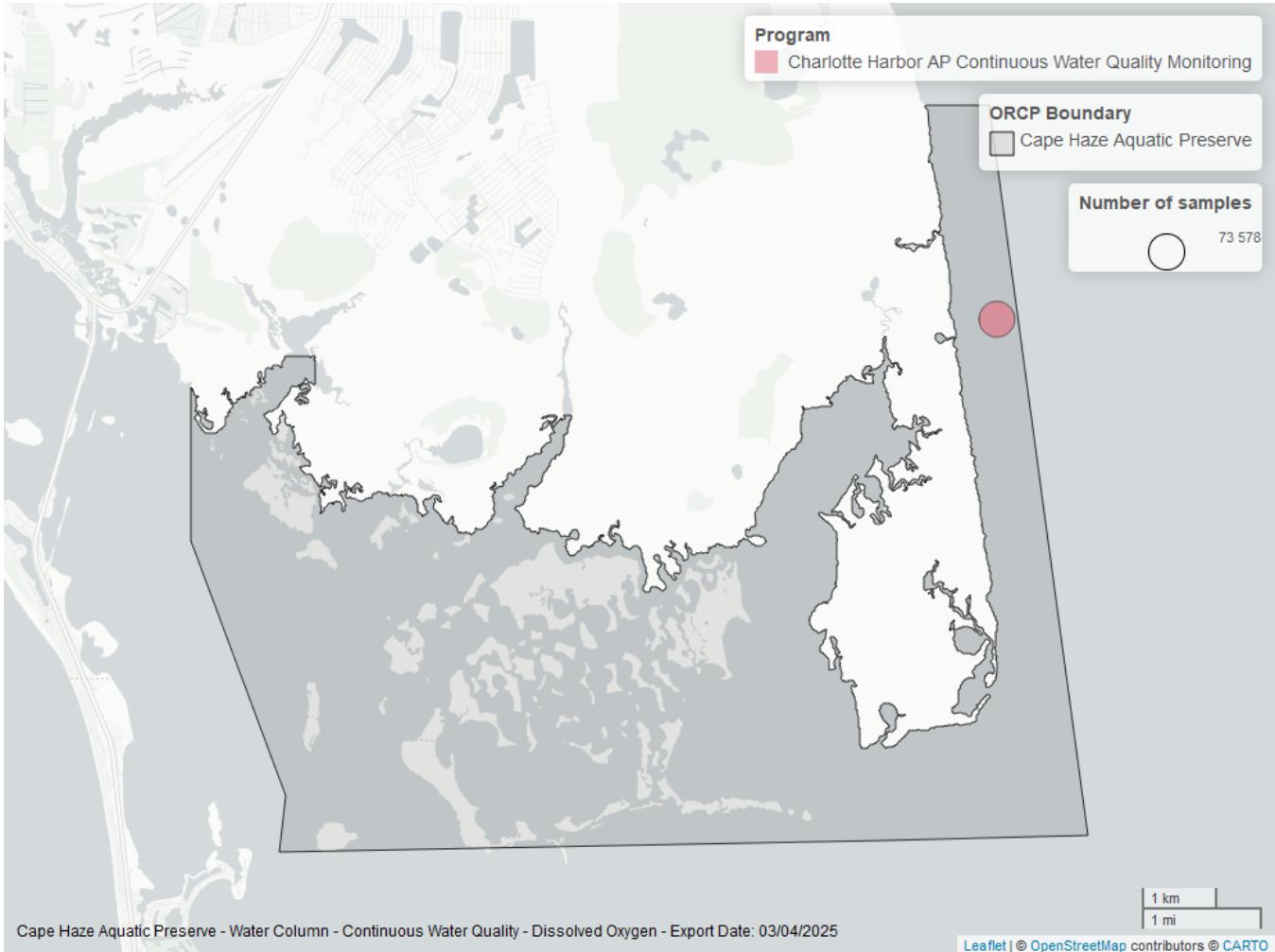


Figure 25: Map showing location of dissolved oxygen continuous water quality sampling locations within the boundaries of *Cape Haze Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Dissolved Oxygen Saturation - Continuous

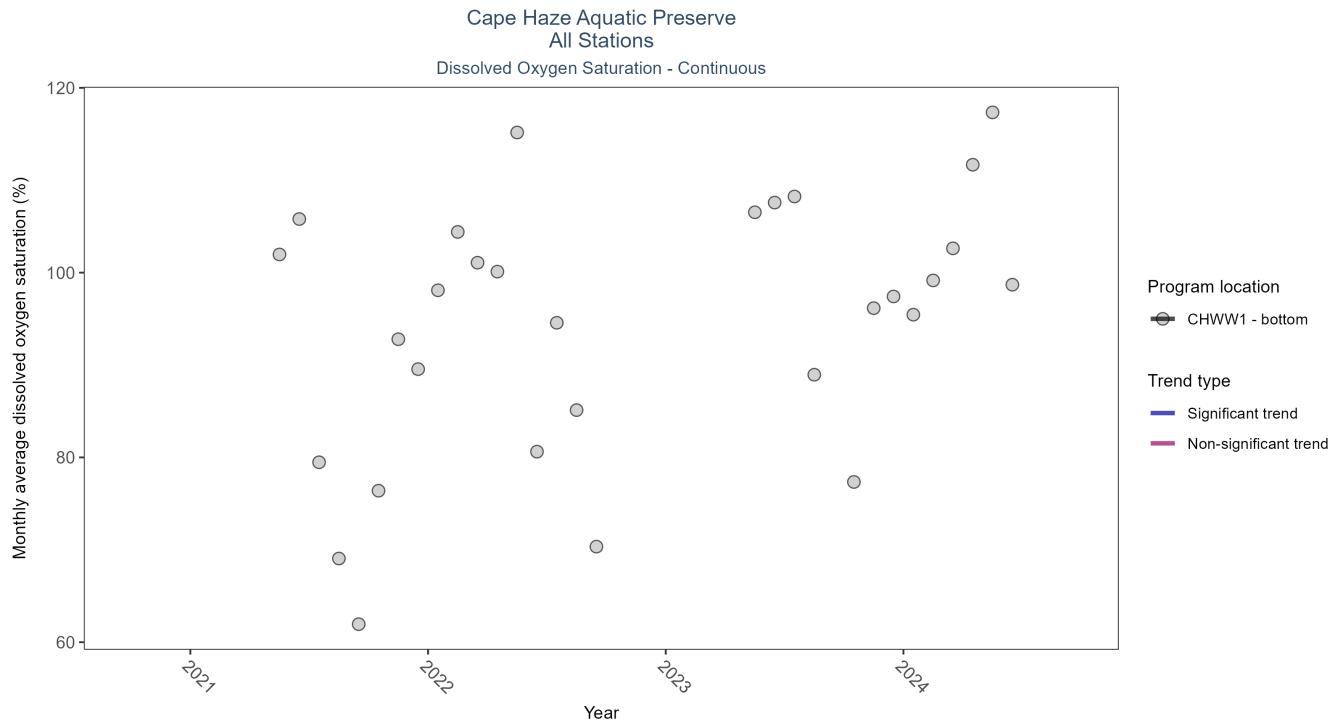


Figure 26: Scatter plot of monthly average dissolved oxygen saturation over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 30: 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
CHWW1	Insufficient data to calculate trend	73535	4	2021 - 2024	94.7	-	-	-	-

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

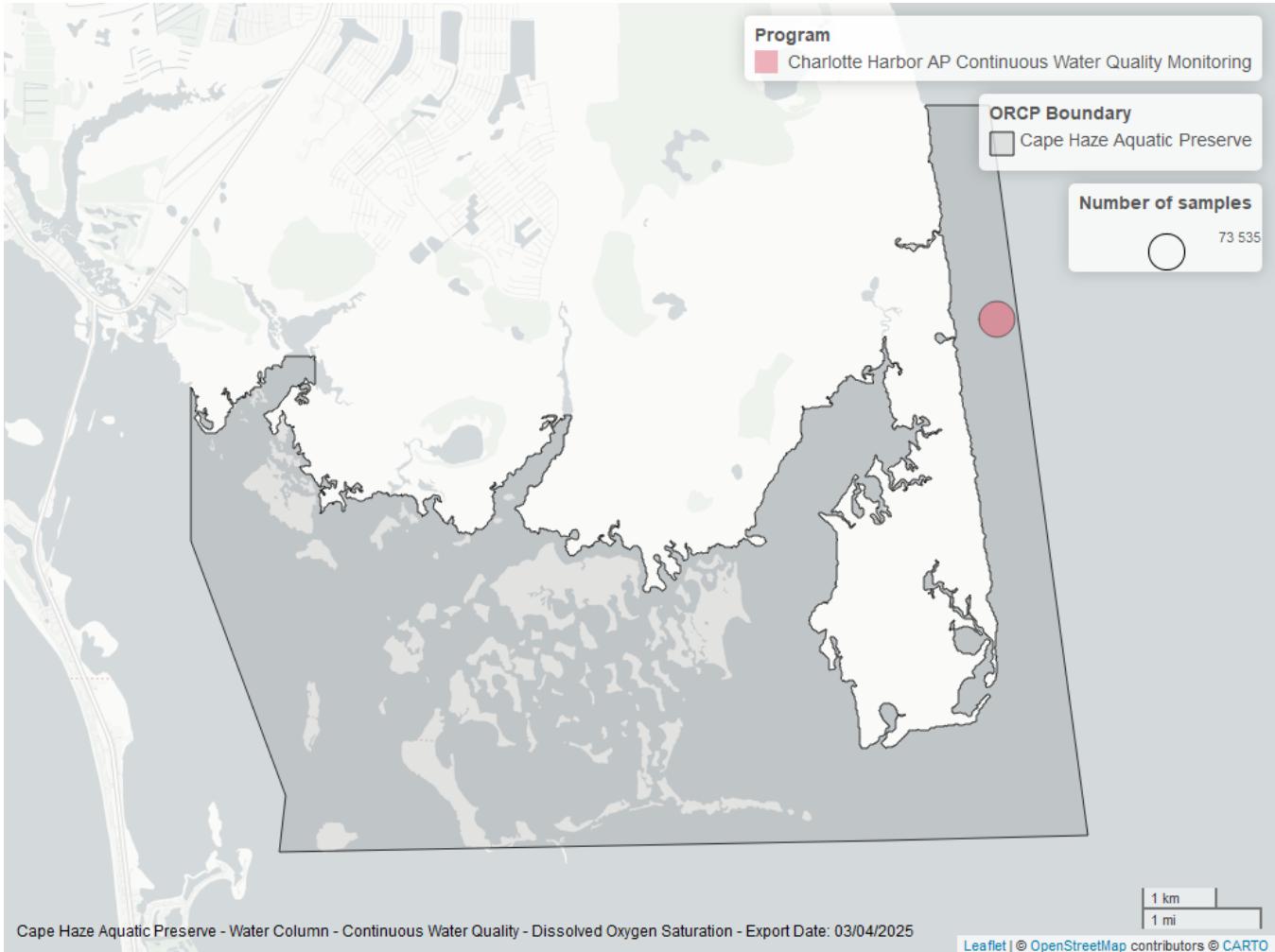


Figure 27: Map showing location of dissolved oxygen saturation continuous water quality sampling locations within the boundaries of *Cape Haze Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

pH - Continuous

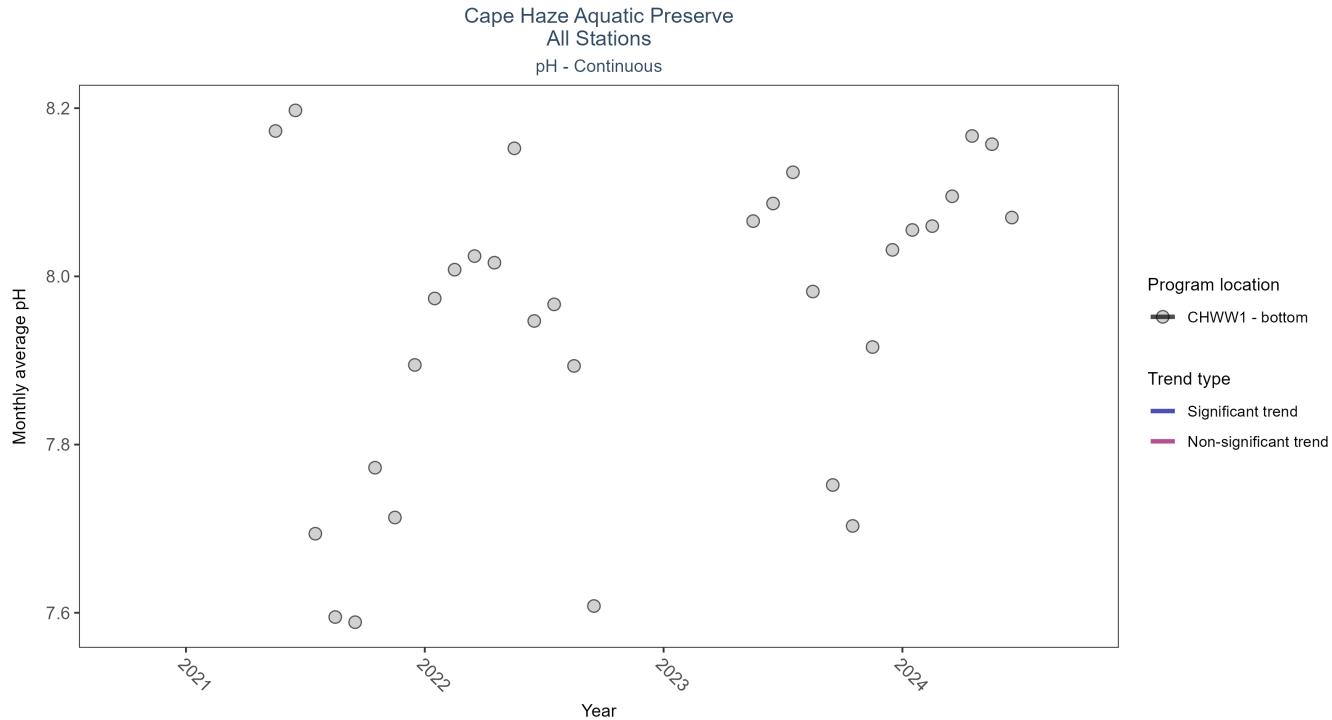


Figure 28: Scatter plot of monthly average pH over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 31: 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
CHWW1	Insufficient data to calculate trend	82652	4	2021 - 2024	8	-	-	-	-

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

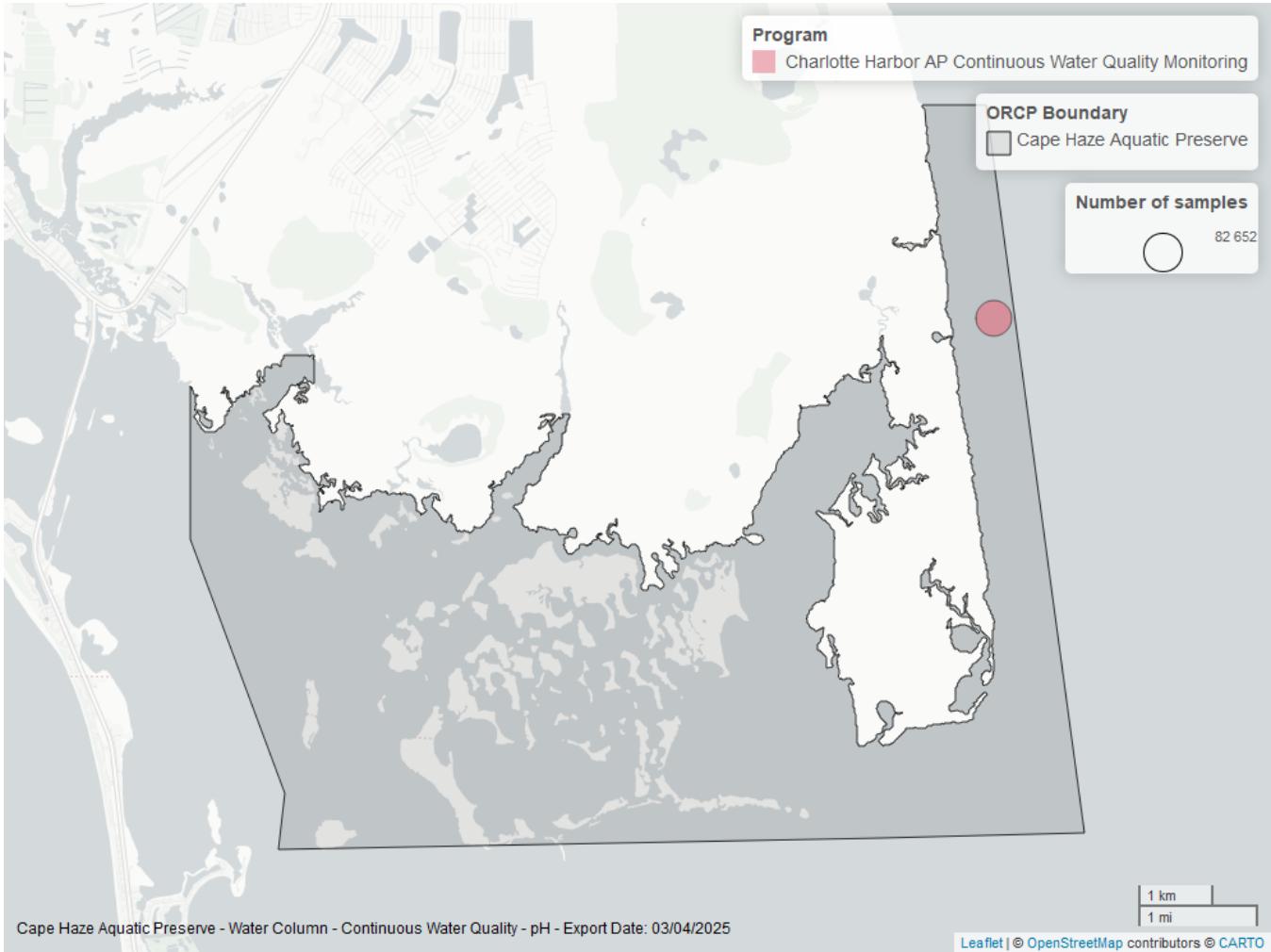


Figure 29: Map showing location of ph continuous water quality sampling locations within the boundaries of *Cape Haze Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Salinity - Continuous

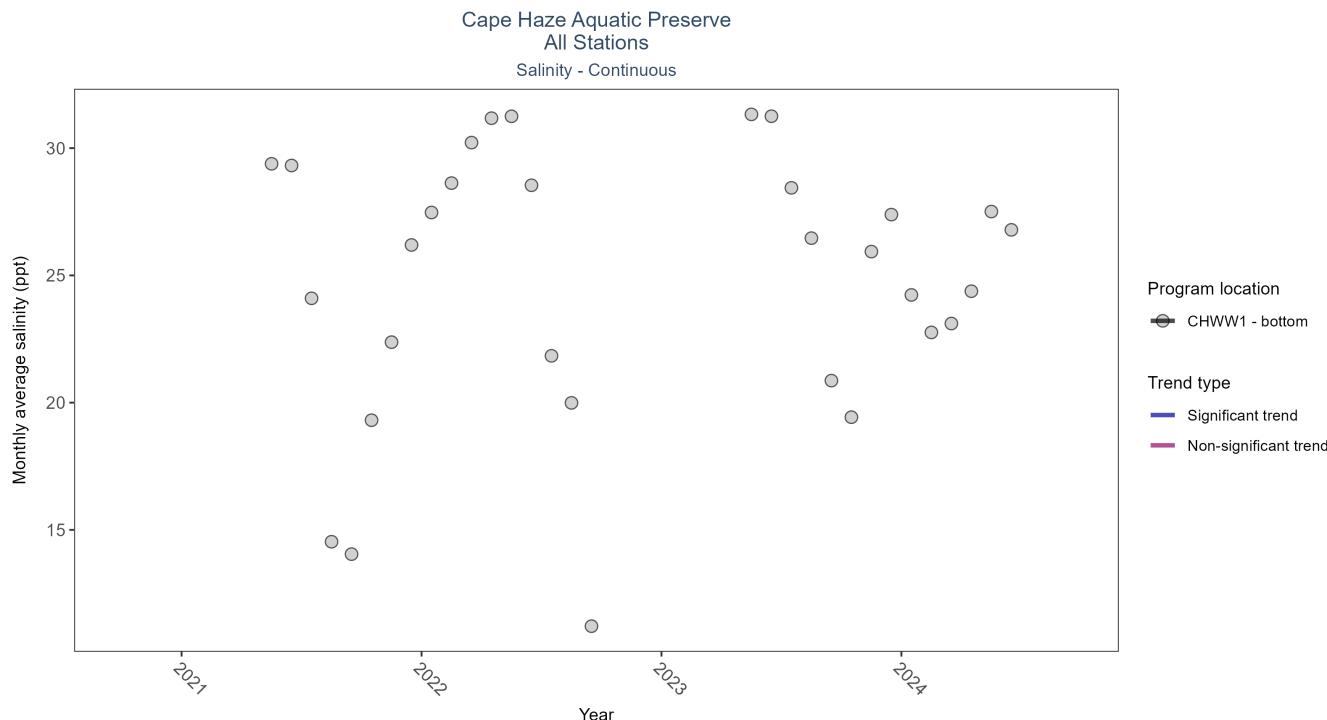


Figure 30: Scatter plot of monthly average salinity over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 32: 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
CHWW1	Insufficient data to calculate trend	79367	4	2021 - 2024	26.5	-	-	-	-

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

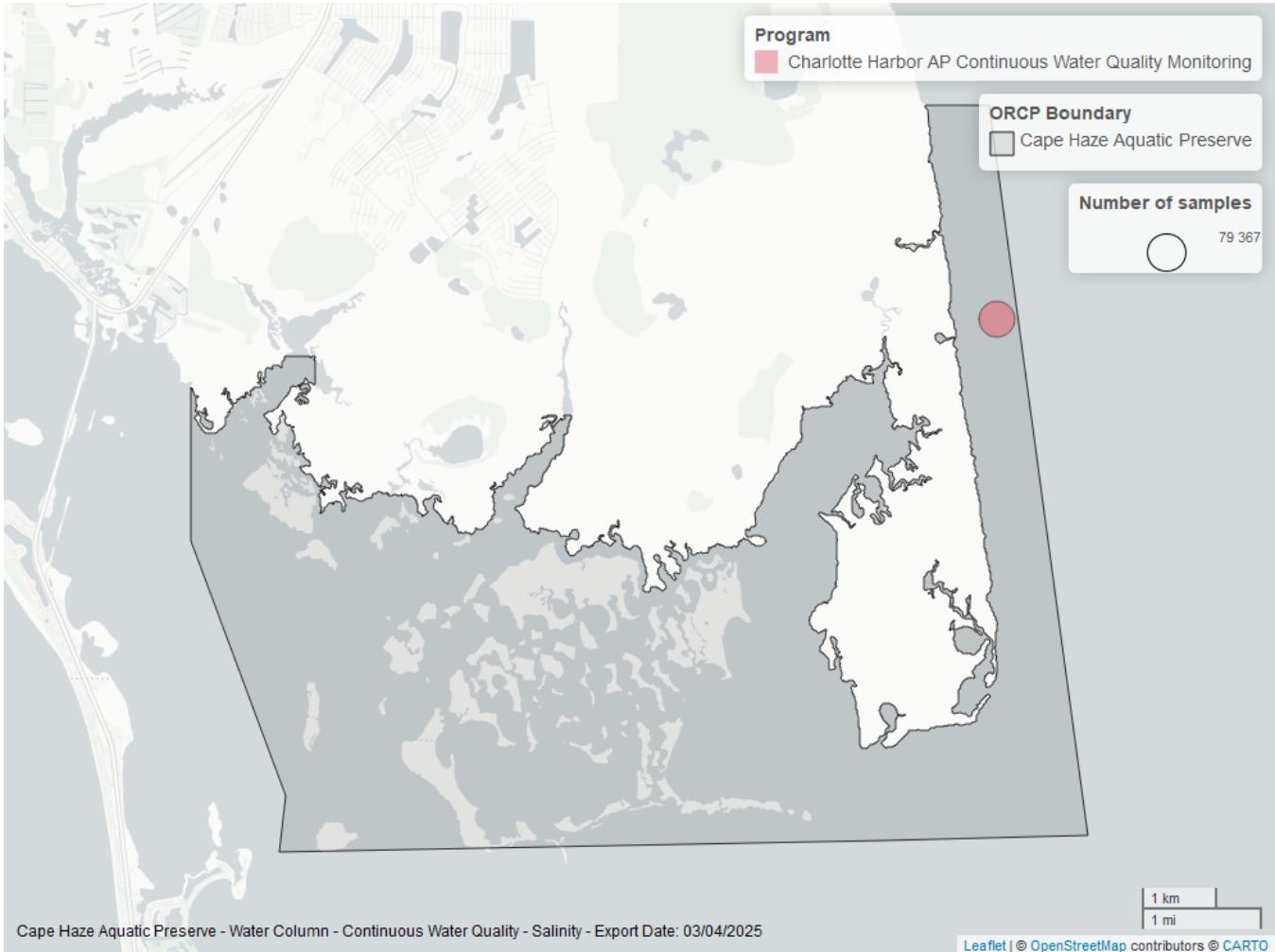


Figure 31: Map showing location of salinity continuous water quality sampling locations within the boundaries of *Cape Haze Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Turbidity - Continuous

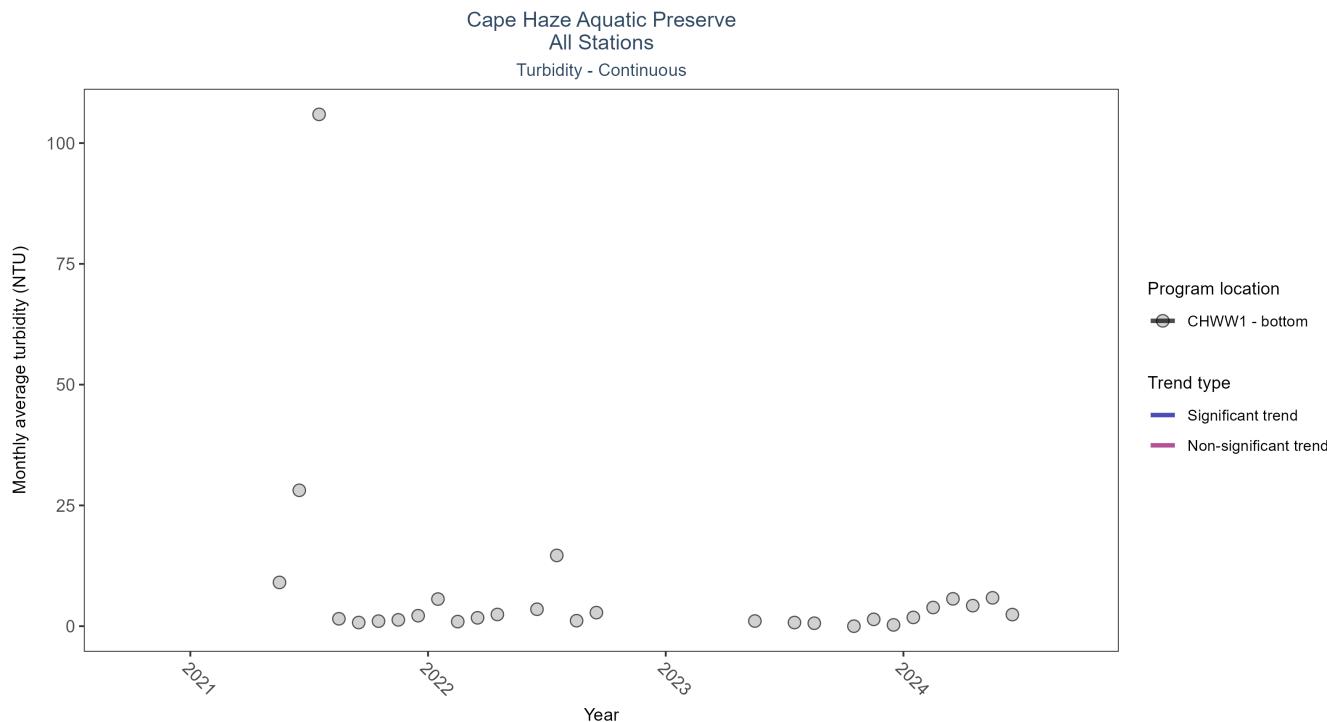


Figure 32: Scatter plot of monthly average turbidity over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 33: 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
CHWW1	Insufficient data to calculate trend	54960	4	2021 - 2024	1	-	-	-	-

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

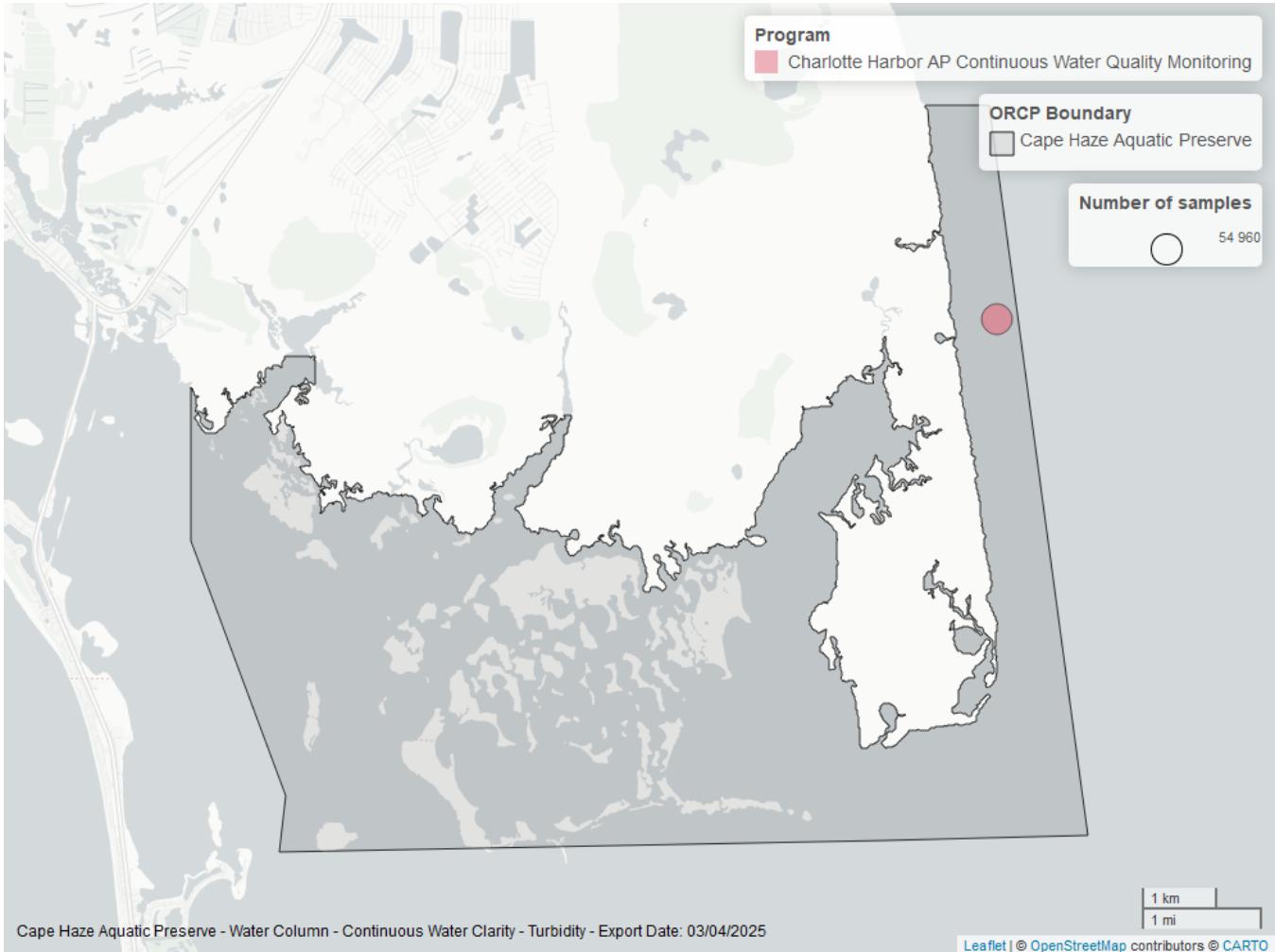


Figure 33: Map showing location of turbidity continuous water quality sampling locations within the boundaries of *Cape Haze Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Water Temperature - Continuous

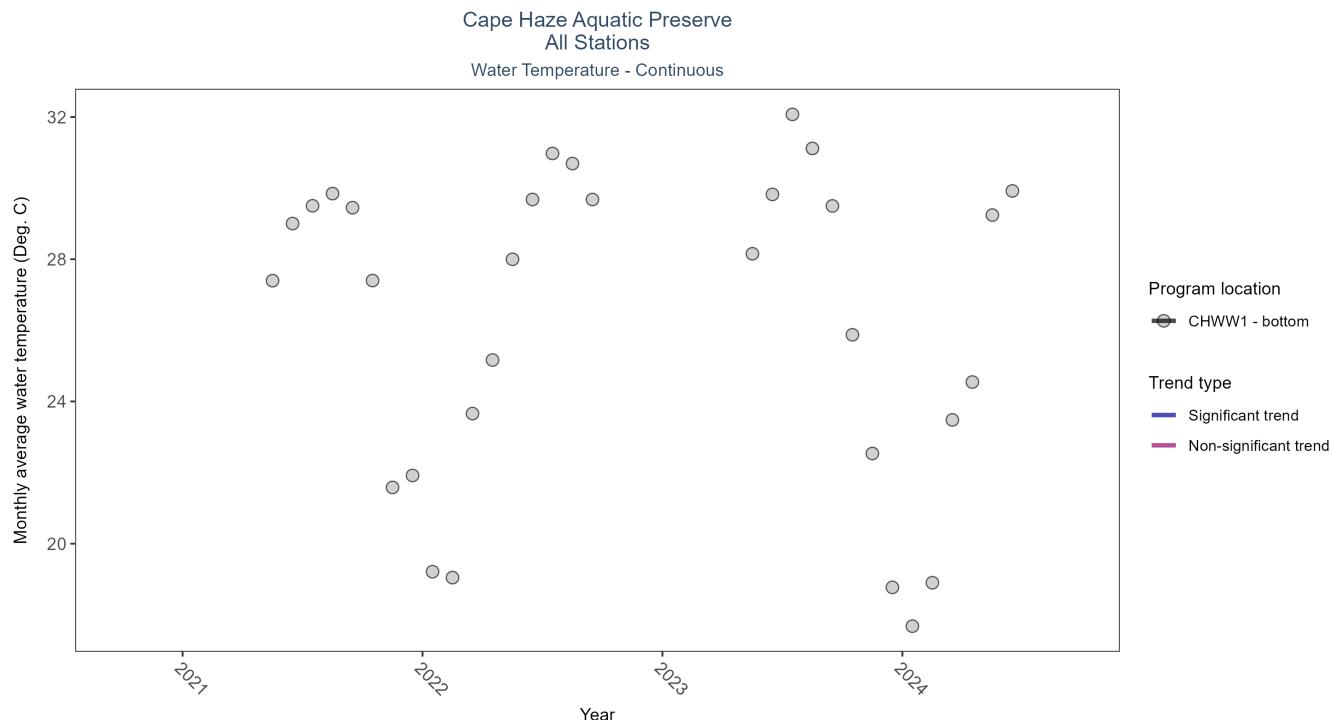


Figure 34: Scatter plot of monthly average water temperature over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 34: 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
CHWW1	Insufficient data to calculate trend	89716	4	2021 - 2024	27.9	-	-	-	-

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

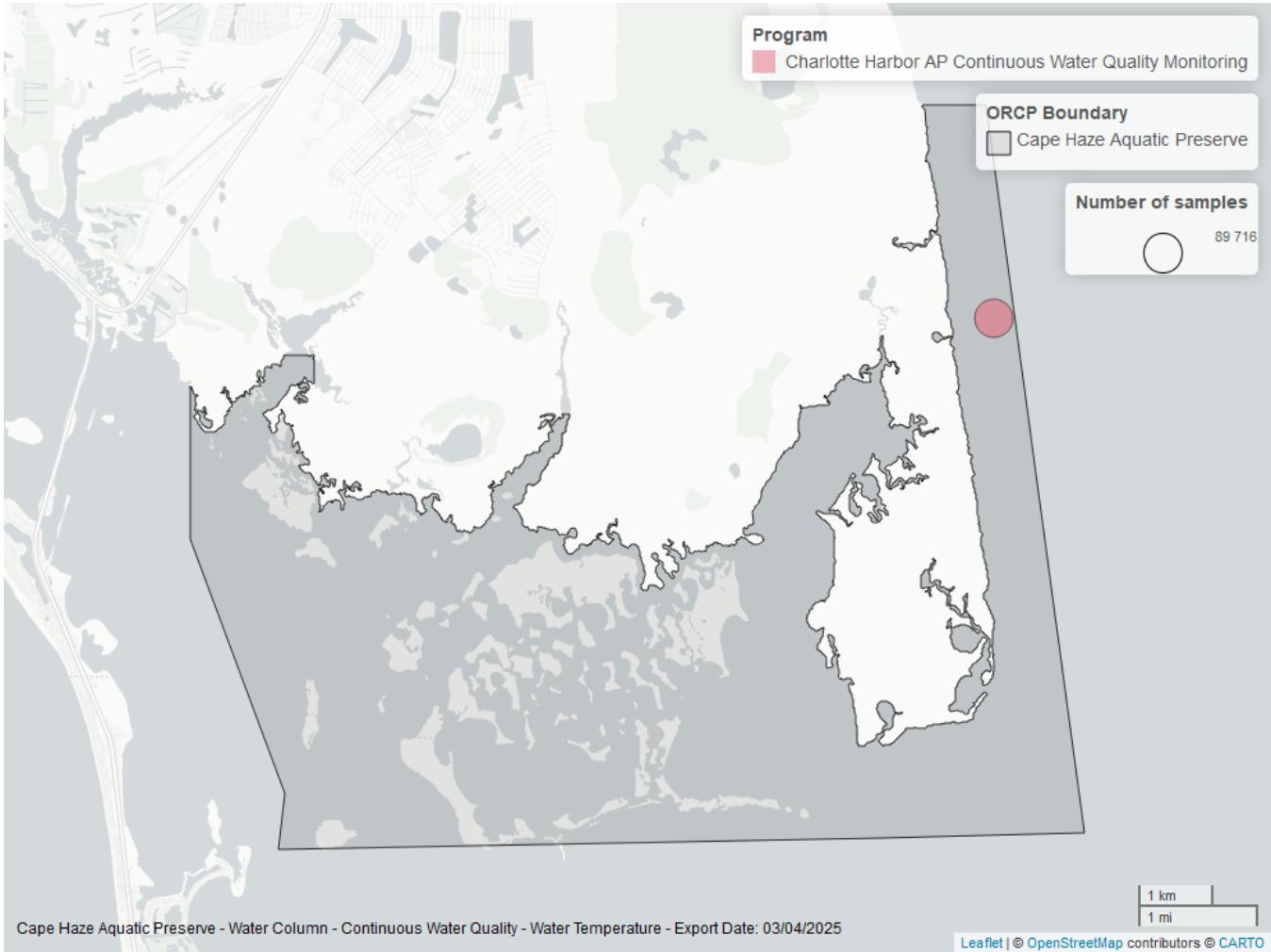


Figure 35: Map showing location of water temperature continuous water quality sampling locations within the boundaries of *Cape Haze Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

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

Cape Haze Aquatic Preserve
SAV Percent Cover - Sample Locations

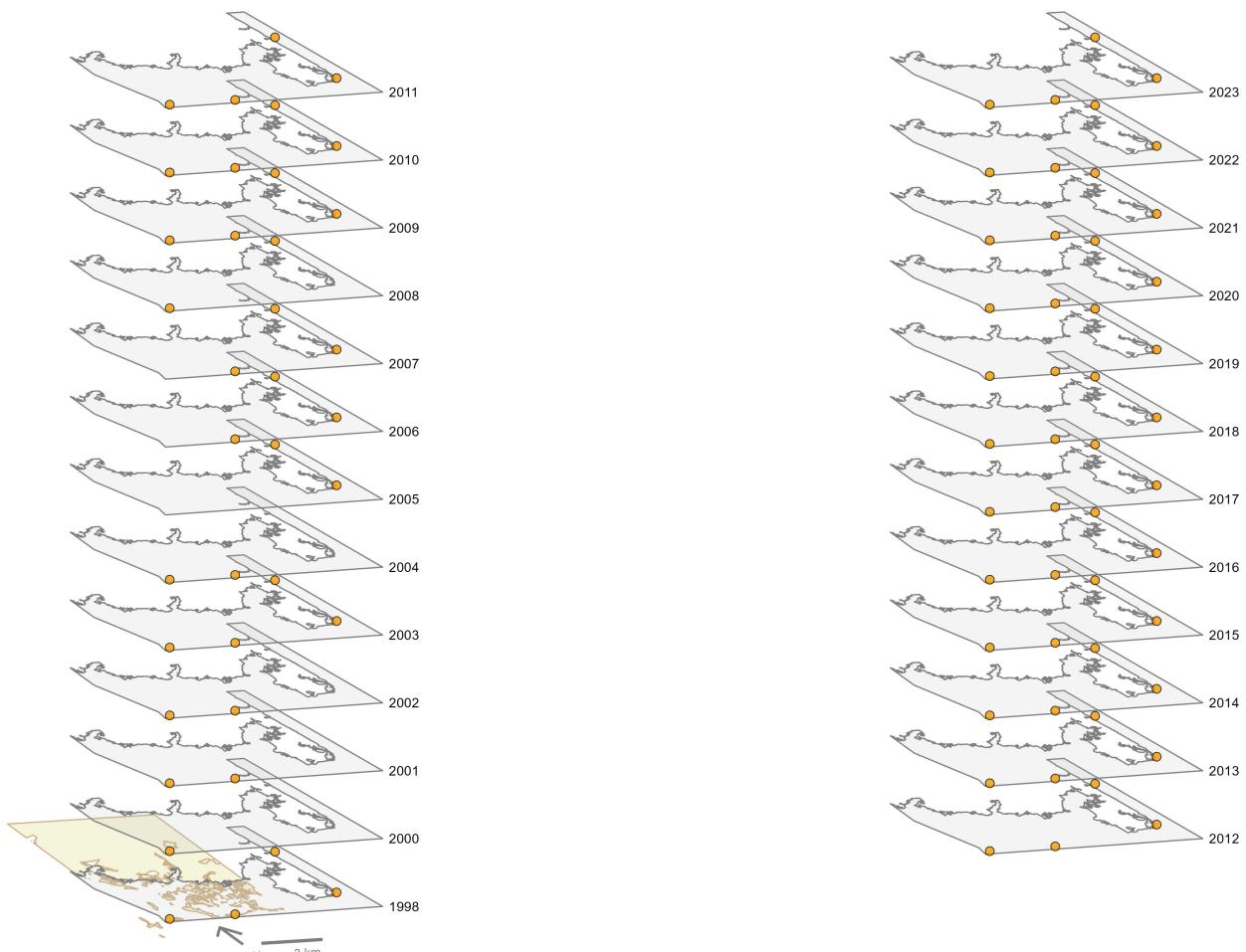


Figure 36: Maps showing the temporal scope of SAV sampling sites within the boundaries of *Cape Haze Aquatic Preserve* by Program name.

Click [here](#) to view spatio-temporal plots on GitHub.

Sampling locations by Program:

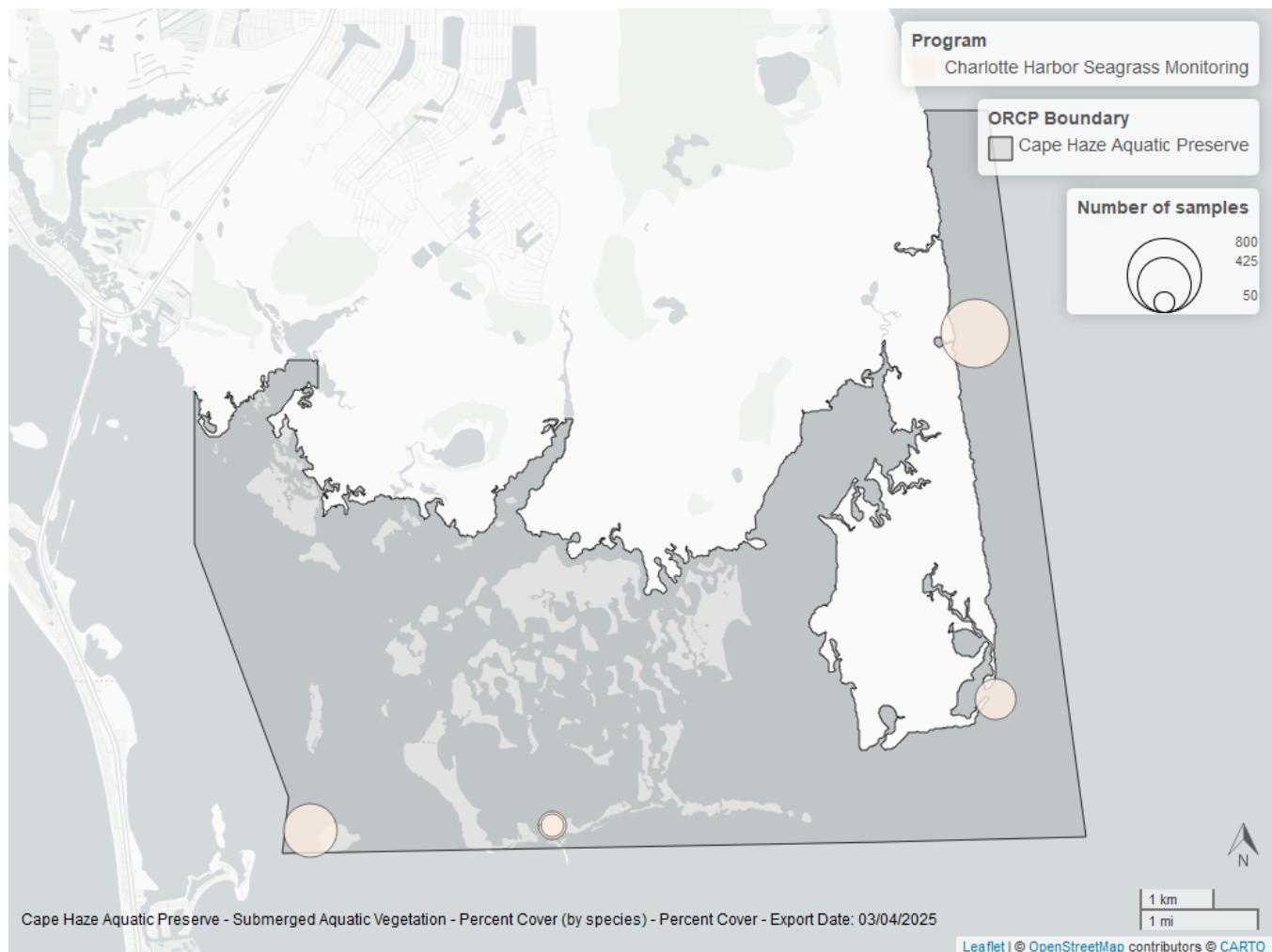


Figure 37: Map showing SAV sampling sites within the boundaries of *Cape Haze Aquatic Preserve*. The point size reflects the number of samples at a given sampling site.

Table 35: Program Information for Submerged Aquatic Vegetation

ProgramID	N-Data	YearMin	YearMax	method	Sample Locations
570	1649	1998	2023	Braun Blanquet	5

Program names:

570 - Charlotte Harbor Seagrass Monitoring¹⁰

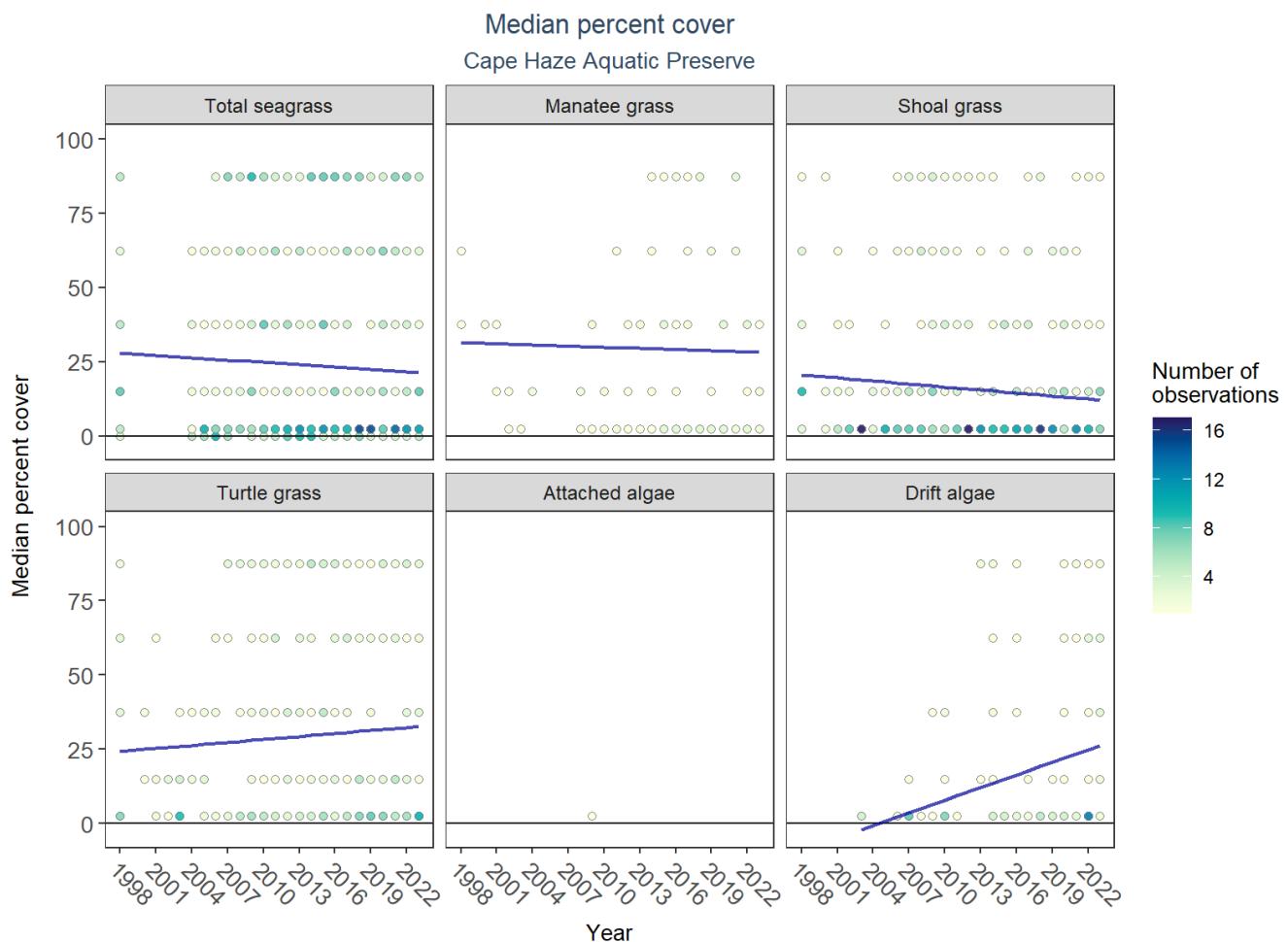


Figure 38: Scatter plots of median percent cover of submerged aquatic vegetation over time by group. Plots for time series that included five or more years of observations show the estimated trend as a blue line.

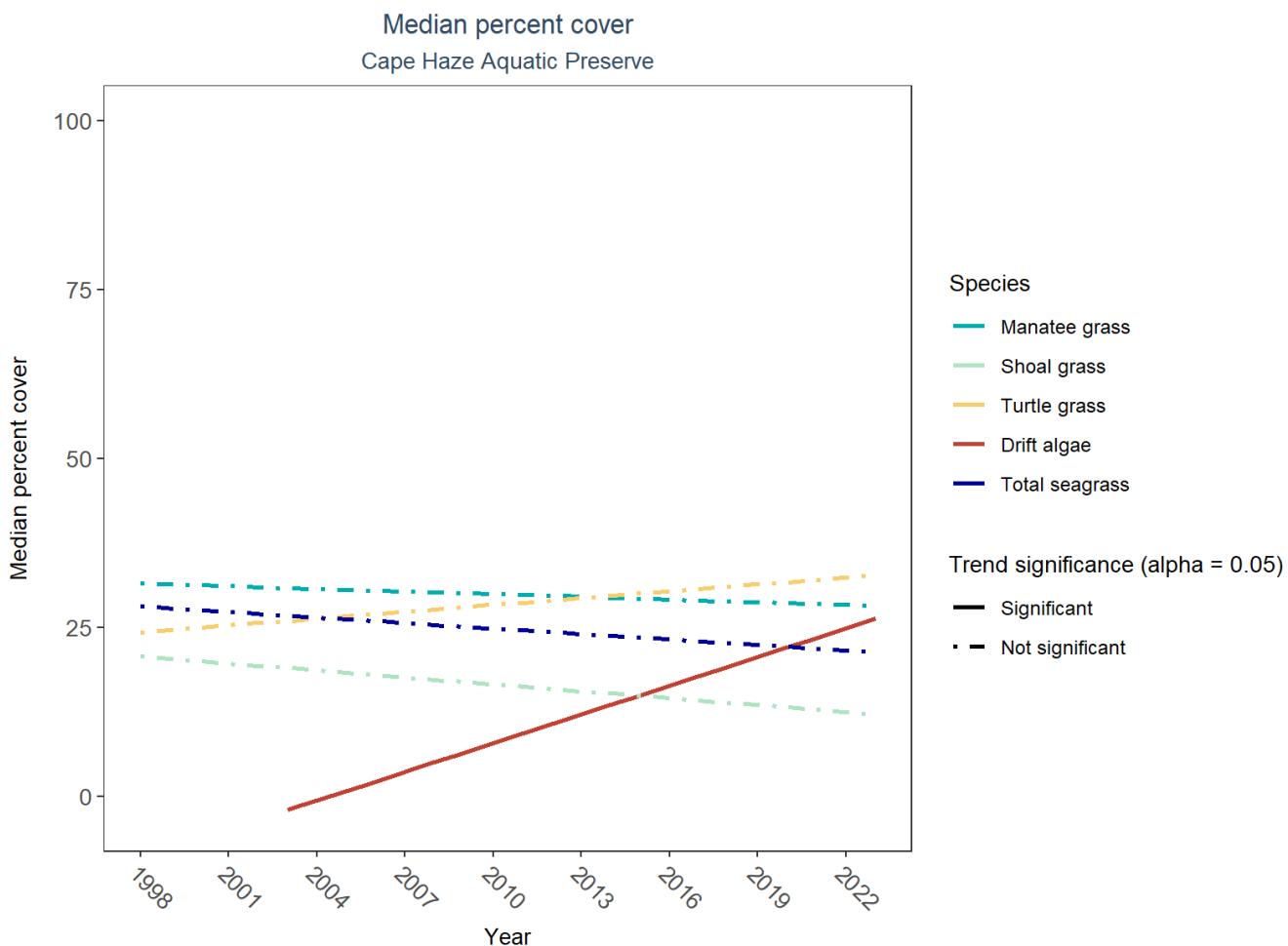


Figure 39: Trends in median percent cover for various seagrass species in Cape Haze Aquatic Preserve - simplified

Table 36: Percent Cover Trend Analysis for Cape Haze Aquatic Preserve

CommonName	Trend Significance (0.05)	Period of Record	LME-Intercept	LME-Slope	p
Attached algae	Insufficient data to calculate trend	-	-	-	-
Drift algae	Significantly increasing trend	2003 - 2023	-14.78335	1.4146323	0.0035242
Shoal grass	No significant trend	1998 - 2023	22.00580	-0.3403338	0.3746461
No grass in quadrat	Model did not fit the available data	1998 - 2023	-	-	-
Manatee grass	No significant trend	1998 - 2023	32.01037	-0.1320942	0.9012668
Turtle grass	No significant trend	1998 - 2023	22.92529	0.3365142	0.2946734
Total seagrass	No significant trend	1998 - 2023	29.14994	-0.2702946	0.5092020

An annual increase in percent cover was observed for drift algae (1.4%). Total seagrass, manatee grass, shoal grass, and turtle grass showed no detectable change in percent cover. Trends in percent cover could not be evaluated for attached algae due to insufficient data.

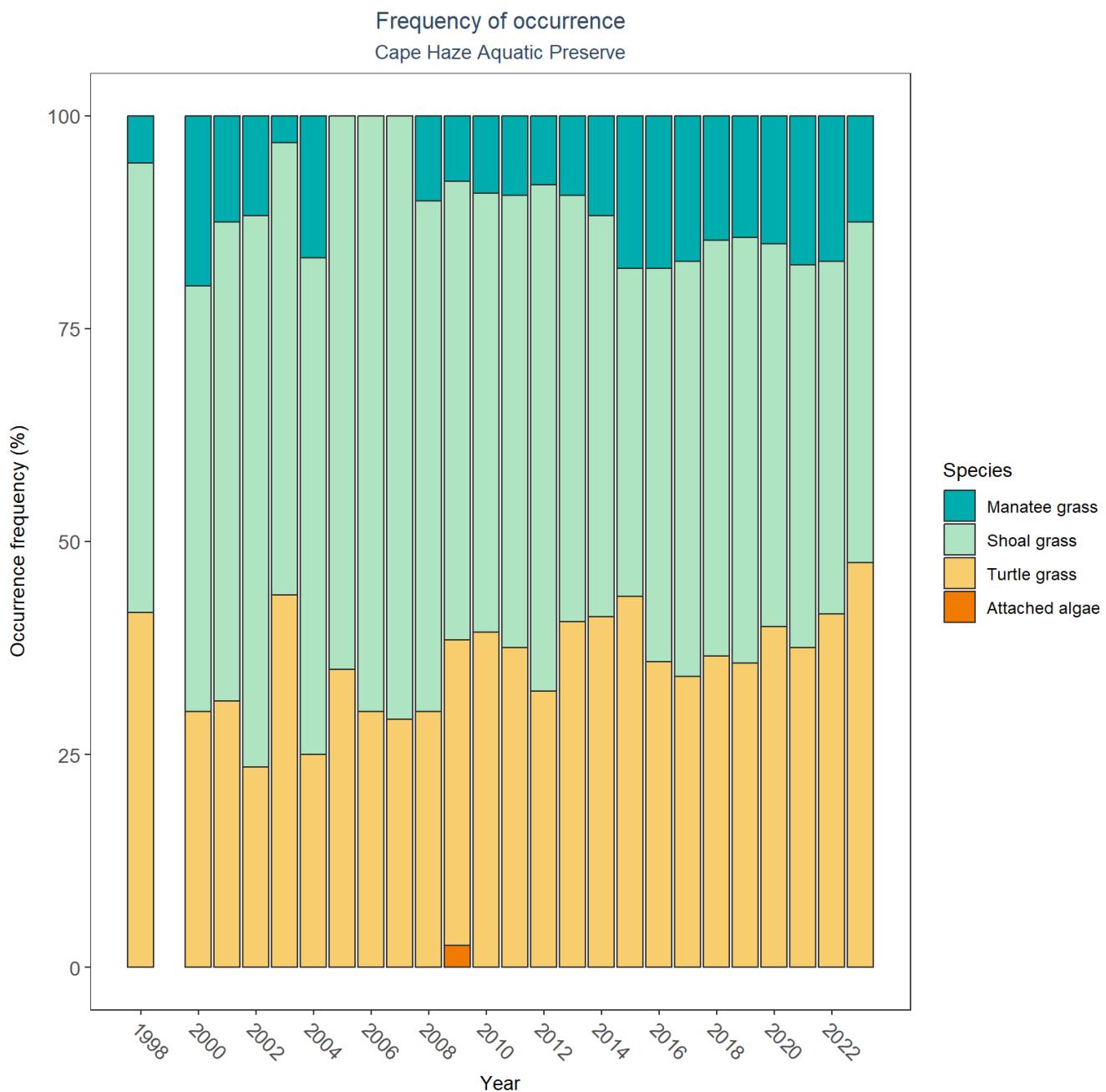


Figure 40: Frequency of occurrence for various seagrass species in Cape Haze Aquatic Preserve

References

1. Florida Department of Environmental Protection (DEP); Office of Resilience and Coastal Protection (RCP); Charlotte Harbor Aquatic Preserves. [Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network](#). (2024).
2. Charlotte Harbor National Estuary Program (CHNEP). [Coastal Charlotte Harbor Monitoring Network](#). (2024).
3. Florida Department of Environmental Protection (DEP). [Florida STORET / WIN](#). (2024).
4. Florida Department of Environmental Protection (DEP); Office of Resilience and Coastal Protection (RCP); Charlotte Harbor Aquatic Preserves. [Charlotte Harbor Aquatic Preserves Monthly Water Quality Program](#). (2024).
5. U.S. Environmental Protection Agency (EPA). [EPA STOrage and RETrieval Data Warehouse \(STORET\)/WQX](#). (2023).
6. Florida Fish and Wildlife Conservation Commission (FWC). [Fisheries-Independent Monitoring \(FIM\) Program](#). (2022).
7. Florida Fish and Wildlife Conservation Commission (FWC); Florida Fish and Wildlife Research Institute (FWRI). [Harmful Algal Bloom Marine Observation Network](#). (2018).
8. Southwest Florida Water Management District (SWFWMD). [Southwest Florida Water Management District - Water Quality Monitoring](#). (2024).
9. Florida Department of Environmental Protection (DEP); Office of Resilience and Coastal Protection (RCP); Charlotte Harbor Aquatic Preserves. [Charlotte Harbor Aquatic Preserves Continuous Water Quality Monitoring](#). (2024).
10. Florida Department of Environmental Protection (DEP); Office of Resilience and Coastal Protection (RCP); Charlotte Harbor Aquatic Preserves. [Charlotte Harbor Seagrass Monitoring](#). (2023).