

Indian River-Vero Beach to Ft. Pierce Aquatic Preserve

SEACAR Habitat Analyses

Last compiled on 08 October, 2025

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Funding & Acknowledgements

The data used in this analysis is from the Export Standardized Tables in the SEACAR Data Discovery Interface (DDI). Documents and information available through the SEACAR DDI are owned by the data provider(s) and users are expected to provide appropriate credit following accepted citation formats. Users are encouraged to access data to maximize utilization of gained knowledge, reducing redundant research and facilitating partnerships and scientific innovation.

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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

<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-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

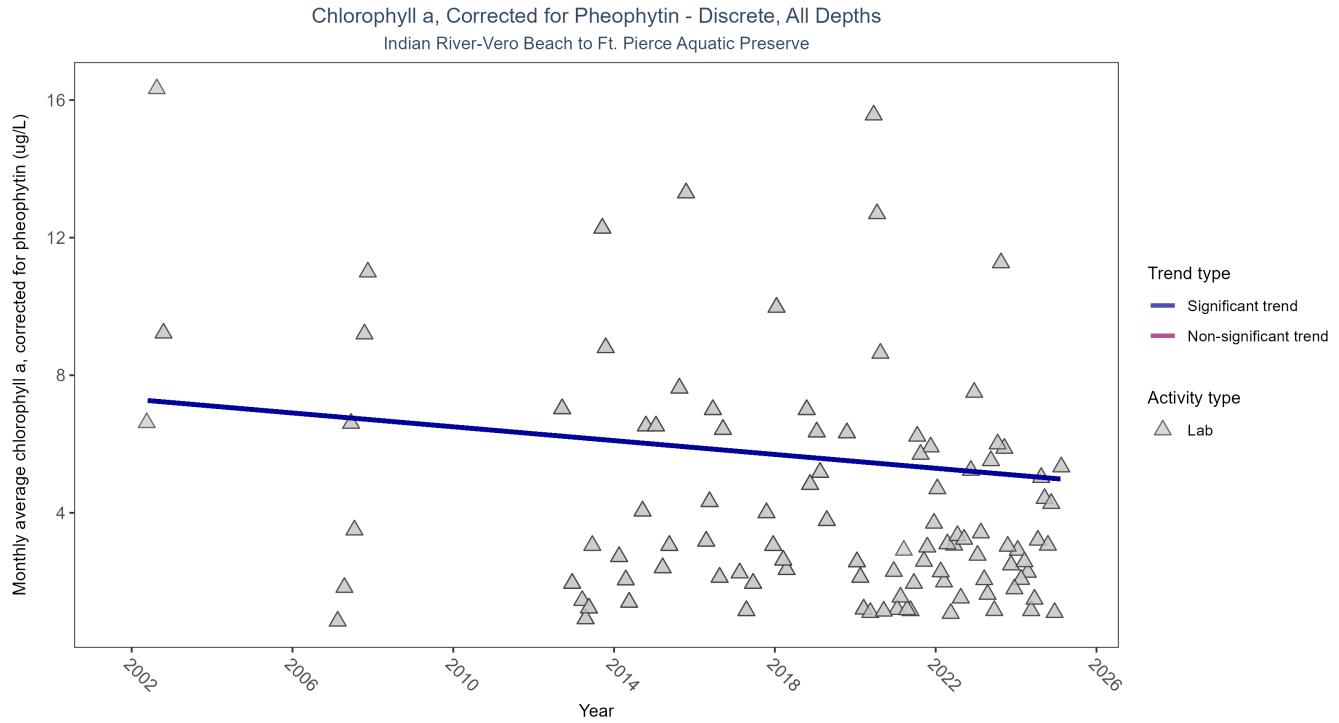


Figure 1: Scatter plot of monthly average levels of chlorophyll a, corrected for pheophytin, over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed chlorophyll a (triangles) 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	279	16	2002 - 2025	3	-0.2204	7.3049	-0.1005	0.0118

Monthly average chlorophyll a, corrected for pheophytin, decreased by 0.1 $\mu\text{g}/\text{L}$ per year, indicating an increase in water clarity.

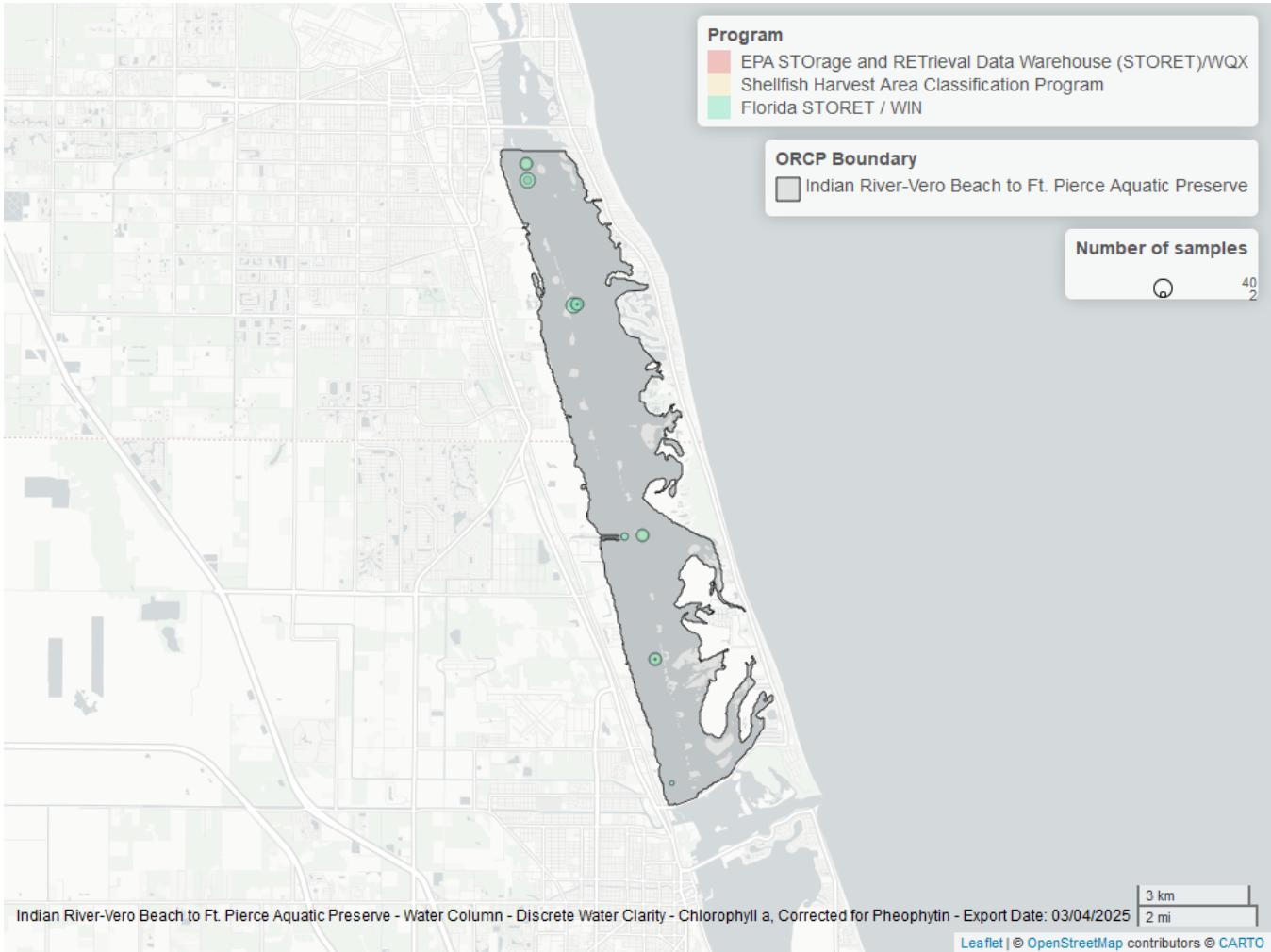


Figure 2: Map showing location of discrete water quality sampling locations within the boundaries of *Indian River-Vero Beach to Ft. Pierce Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

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

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
5002	223	2002	2025
540	60	2016	2020

Program names:

540 - Shellfish Harvest Area Classification Program¹
 5002 - Florida STORET / WIN²

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

Chlorophyll a, Uncorrected for Pheophytin - Discrete, All Depths
Indian River-Vero Beach to Ft. Pierce Aquatic Preserve

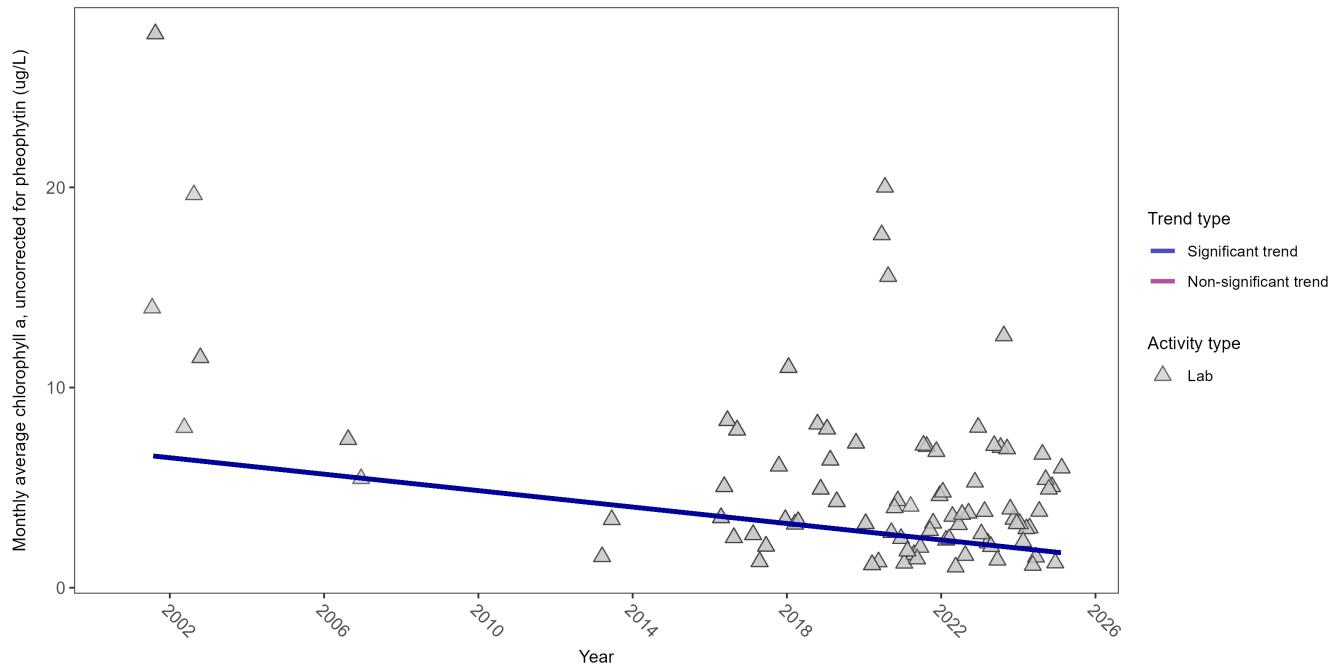


Figure 3: Scatter plot of monthly average levels of chlorophyll a, uncorrected for pheophytin, over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed chlorophyll a (triangles) 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	210	14	2001 - 2025	3.7472	-0.2737	6.6983	-0.2052	0.0016

Monthly average chlorophyll a, uncorrected for pheophytin, decreased by 0.21 $\mu\text{g/L}$ per year, indicating an increase in water clarity.

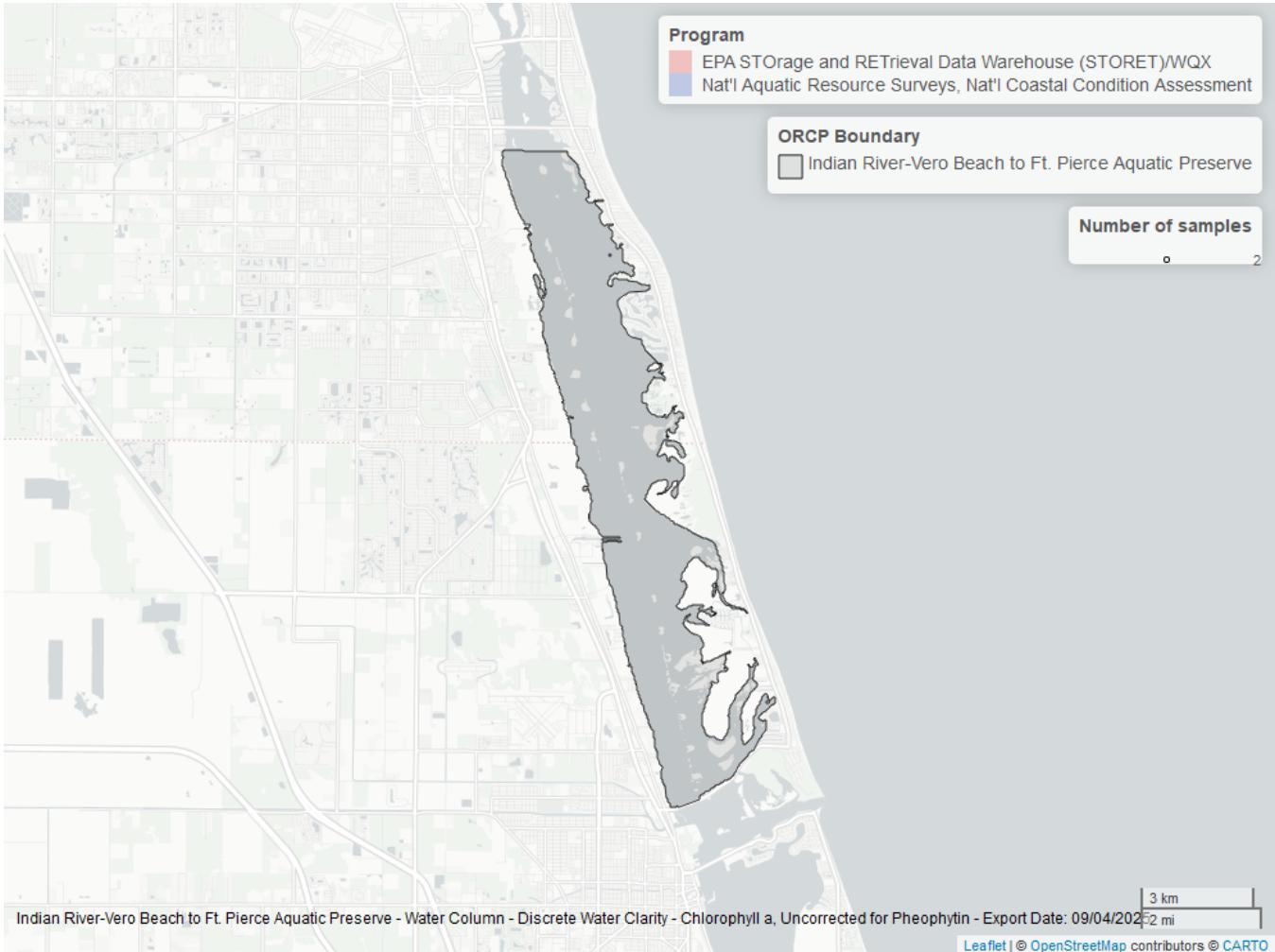


Figure 4: Map showing location of discrete water quality sampling locations within the boundaries of *Indian River-Vero Beach to Ft. Pierce Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

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	151	2001	2025
540	64	2016	2020
103	2	2006	2006
118	1	2006	2006

Program names:

- 103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX³
- 118 - National Aquatic Resource Surveys, National Coastal Condition Assessment⁴
- 540 - Shellfish Harvest Area Classification Program¹
- 5002 - Florida STORET / WIN²

Colored Dissolved Organic Matter - Discrete Seasonal Kendall-Tau Trend Analysis

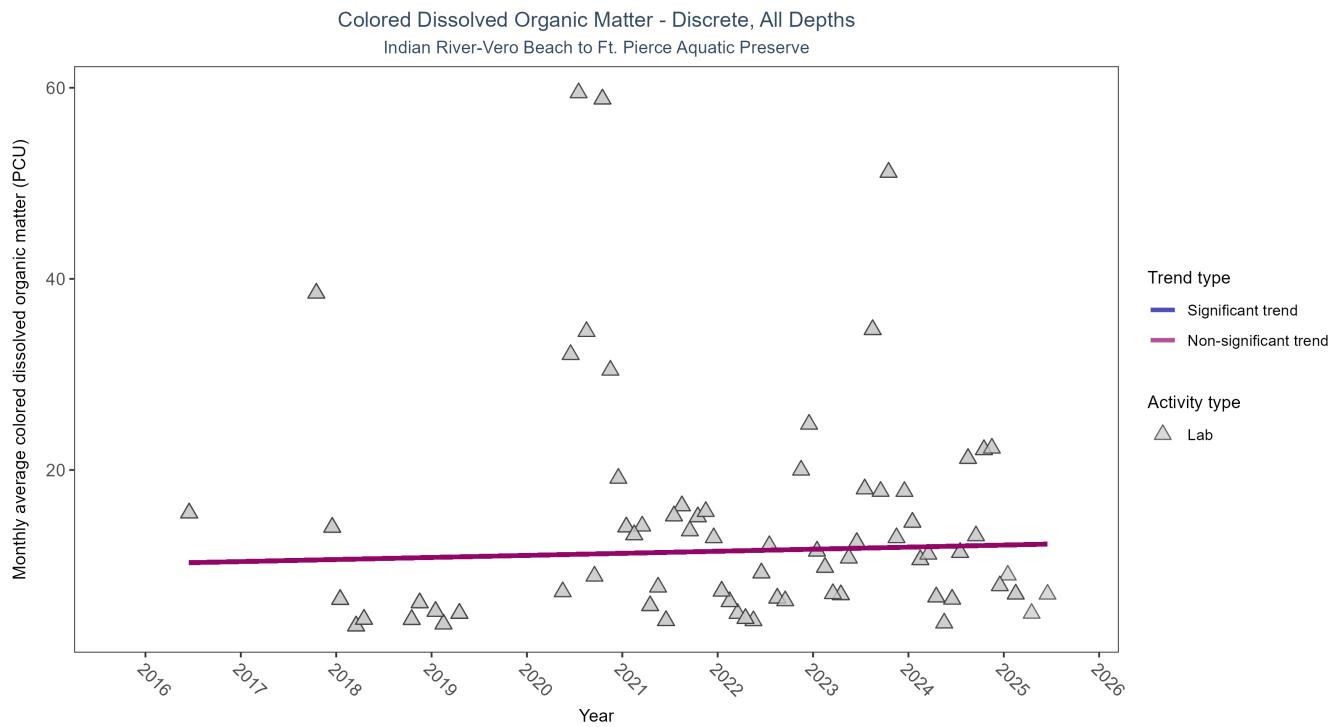


Figure 5: Scatter plot of monthly average colored dissolved organic matter (CDOM) over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed CDOM (triangles) is included in the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

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

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Lab	No significant trend	187	10	2016 - 2025	10.5235	0.0562	10.1982	0.216	0.544

Colored dissolved organic matter showed no detectable trend between 2016 and 2025.

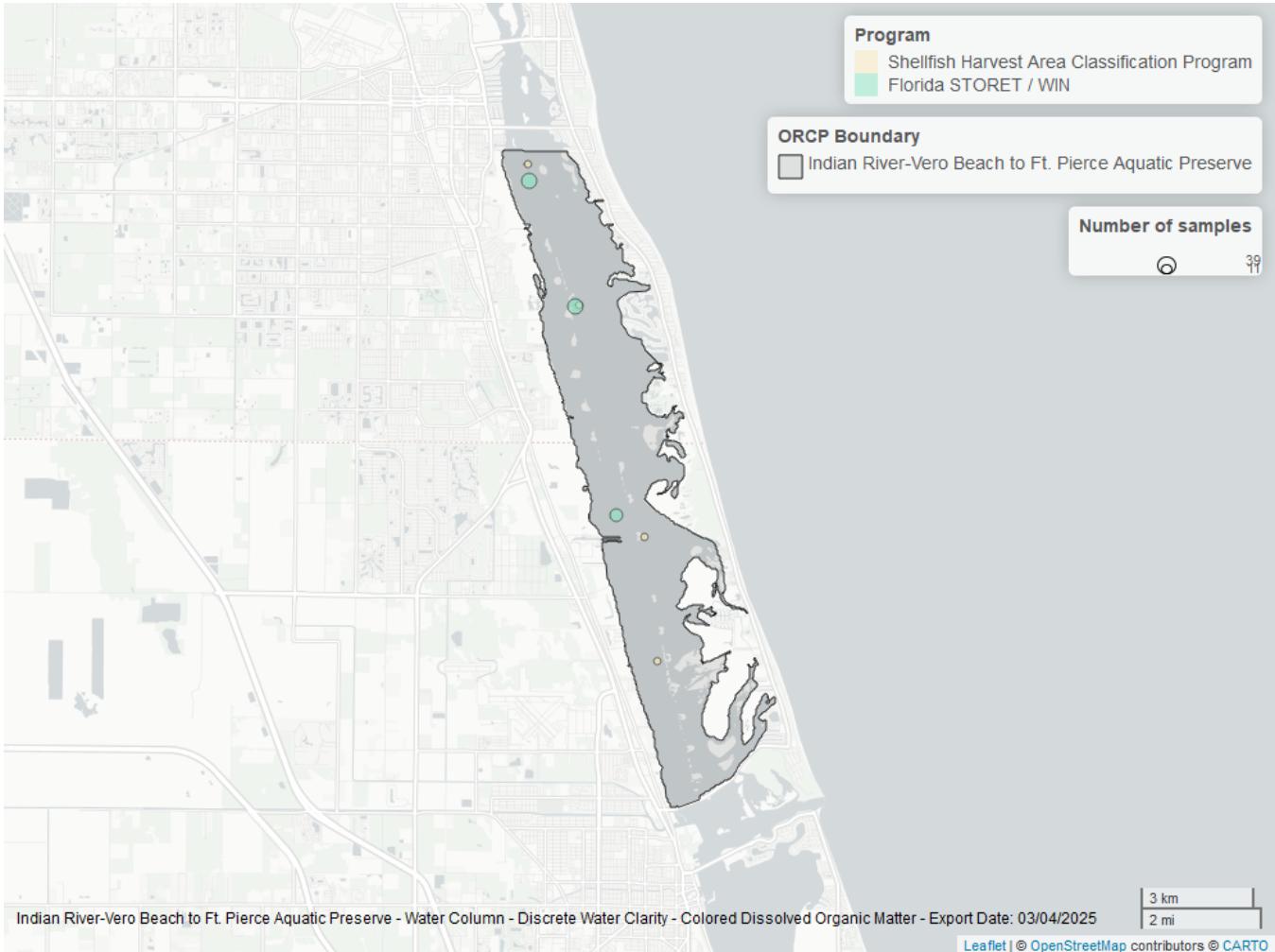


Figure 6: Map showing location of discrete water quality sampling locations within the boundaries of *Indian River-Vero Beach to Ft. Pierce Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 11: Programs contributing data for Colored Dissolved Organic Matter

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
5002	144	2020	2025
540	44	2016	2019

Program names:

540 - Shellfish Harvest Area Classification Program¹
 5002 - Florida STORET / WIN²

Dissolved Oxygen - Discrete

Seasonal Kendall-Tau Trend Analysis

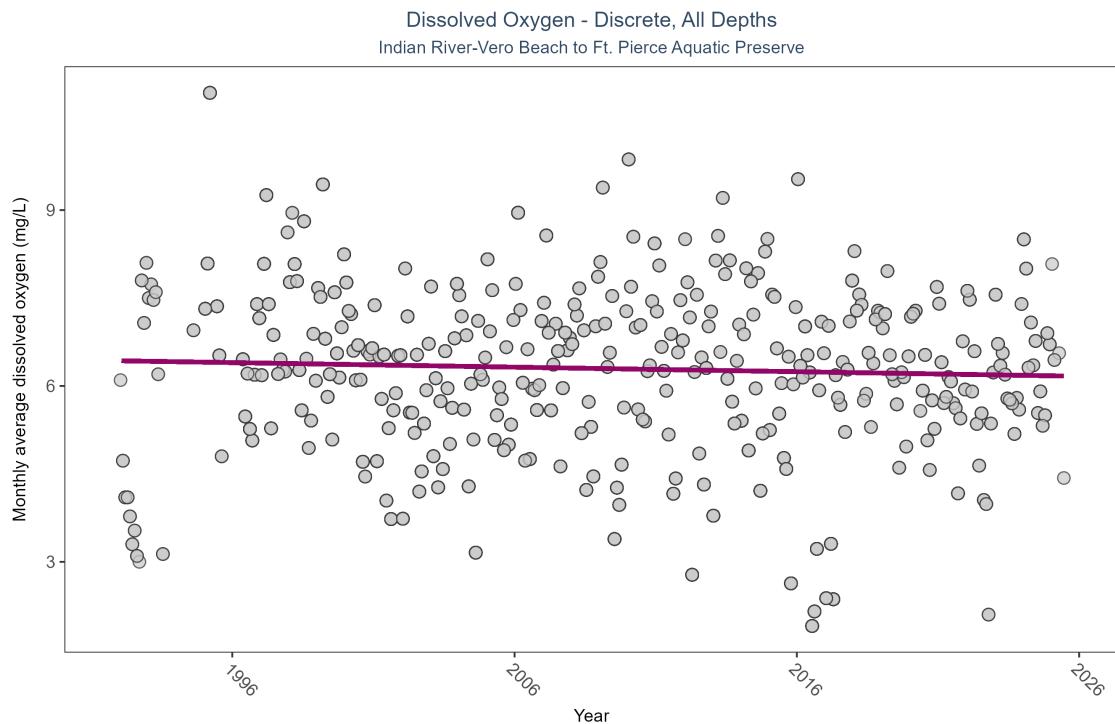


Figure 7: Scatter plot of monthly average dissolved oxygen over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only dissolved oxygen values measured in the field (circles) are included in the plot.

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

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Field	No significant trend	8019	34	1992 - 2025	6.3	-0.0531	6.4294	-0.0078	0.1564

Dissolved oxygen showed no detectable trend between 1992 and 2025.

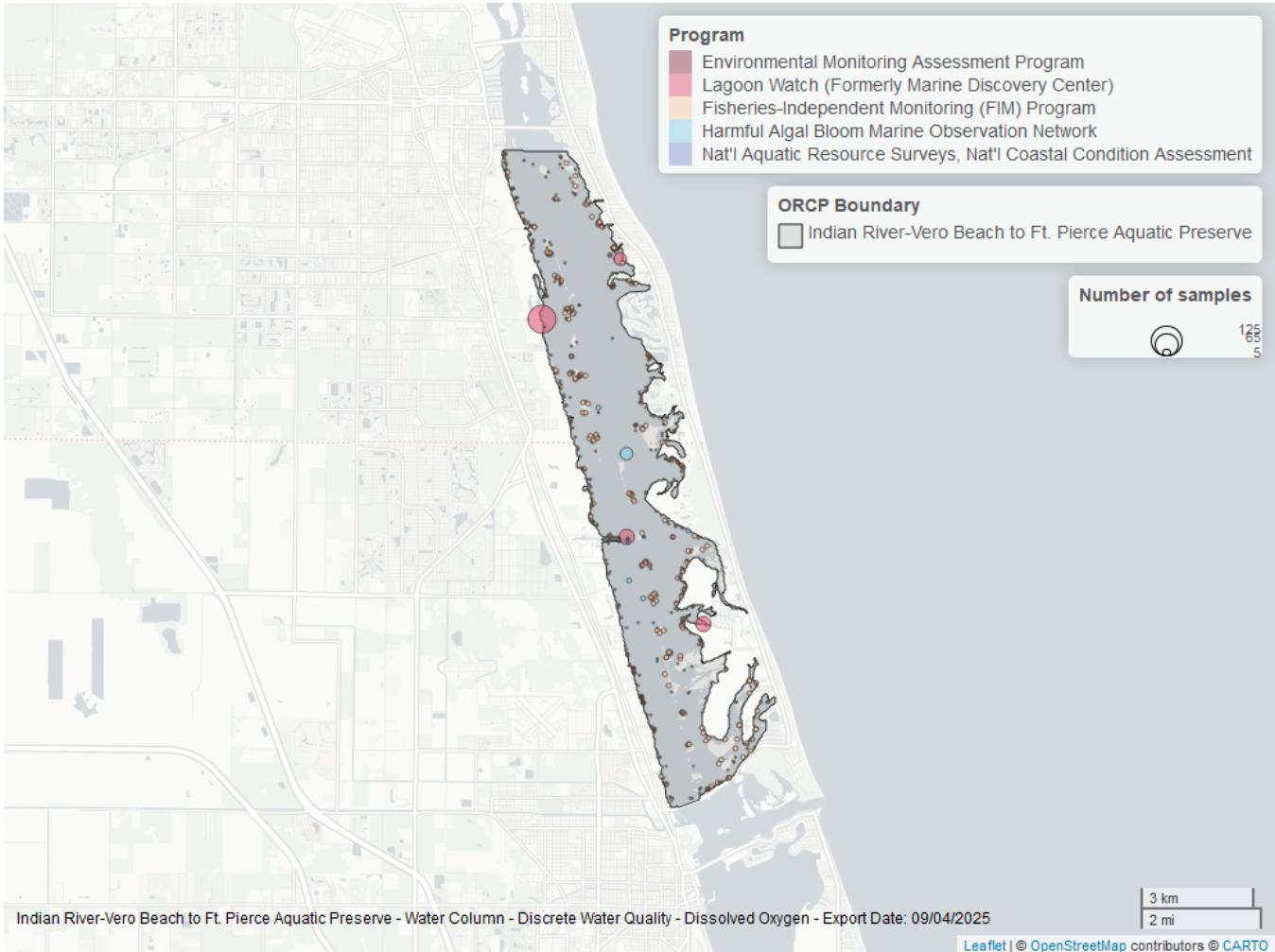


Figure 8: Map showing location of discrete water quality sampling locations within the boundaries of *Indian River-Vero Beach to Ft. Pierce Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 13: Programs contributing data for Dissolved Oxygen

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
5002	5963	1995	2025
69	1332	1998	2024
3013	390	1999	2024
3001	224	1992	2023
95	68	1996	2018
540	56	2016	2020
115	8	1994	1995
118	1	2006	2006

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program⁵

95 - Harmful Algal Bloom Marine Observation Network⁶

115 - Environmental Monitoring Assessment Program⁷

118 - National Aquatic Resource Surveys, National Coastal Condition Assessment⁴

- 540 - Shellfish Harvest Area Classification Program¹
 3001 - Lagoon Watch (Formerly Marine Discovery Center)⁸
 3013 - Seagrass (SJRWMD)⁹
 5002 - Florida STORET / WIN²

Dissolved Oxygen Saturation - Discrete Seasonal Kendall-Tau Trend Analysis

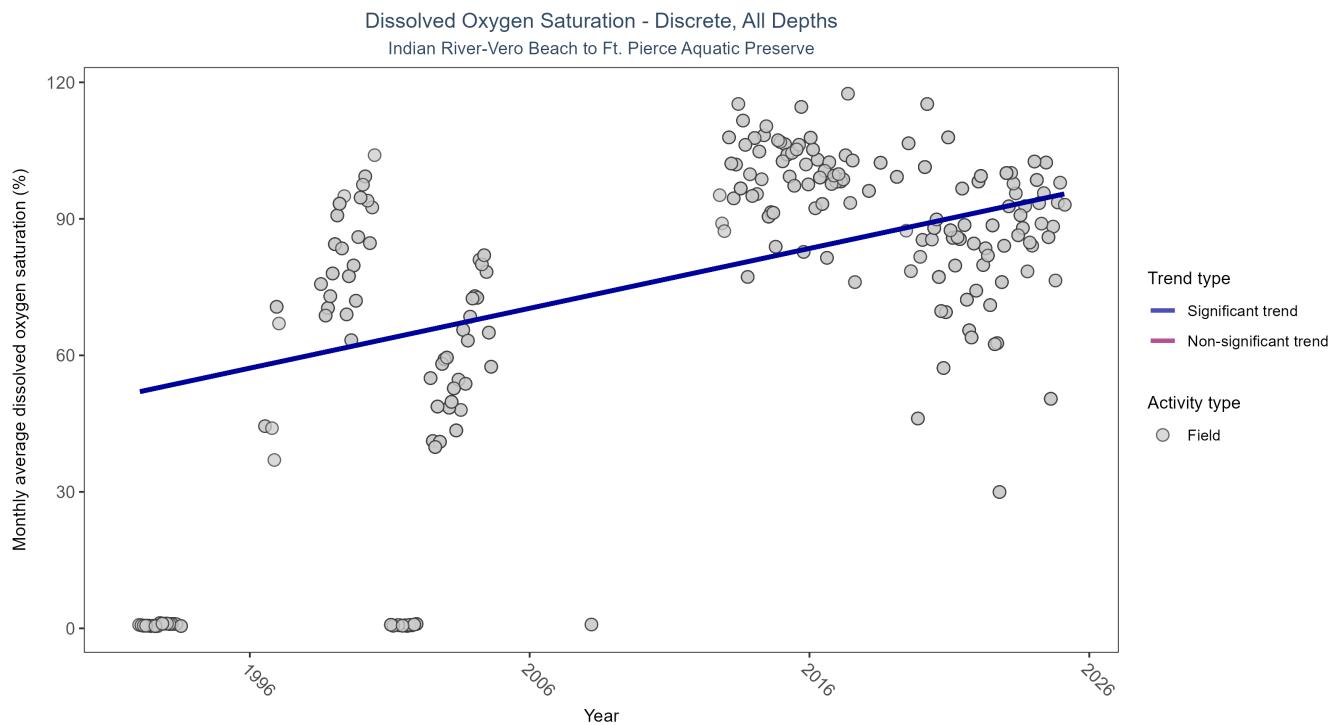


Figure 9: Scatter plot of monthly average dissolved oxygen saturation over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only dissolved oxygen saturation values measured in the field (circles)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

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

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Field	Significantly increasing trend	862	26	1992 - 2025	84.45	0.3441	51.9266	1.3154	0

Monthly average dissolved oxygen saturation increased by 1.32% per year.

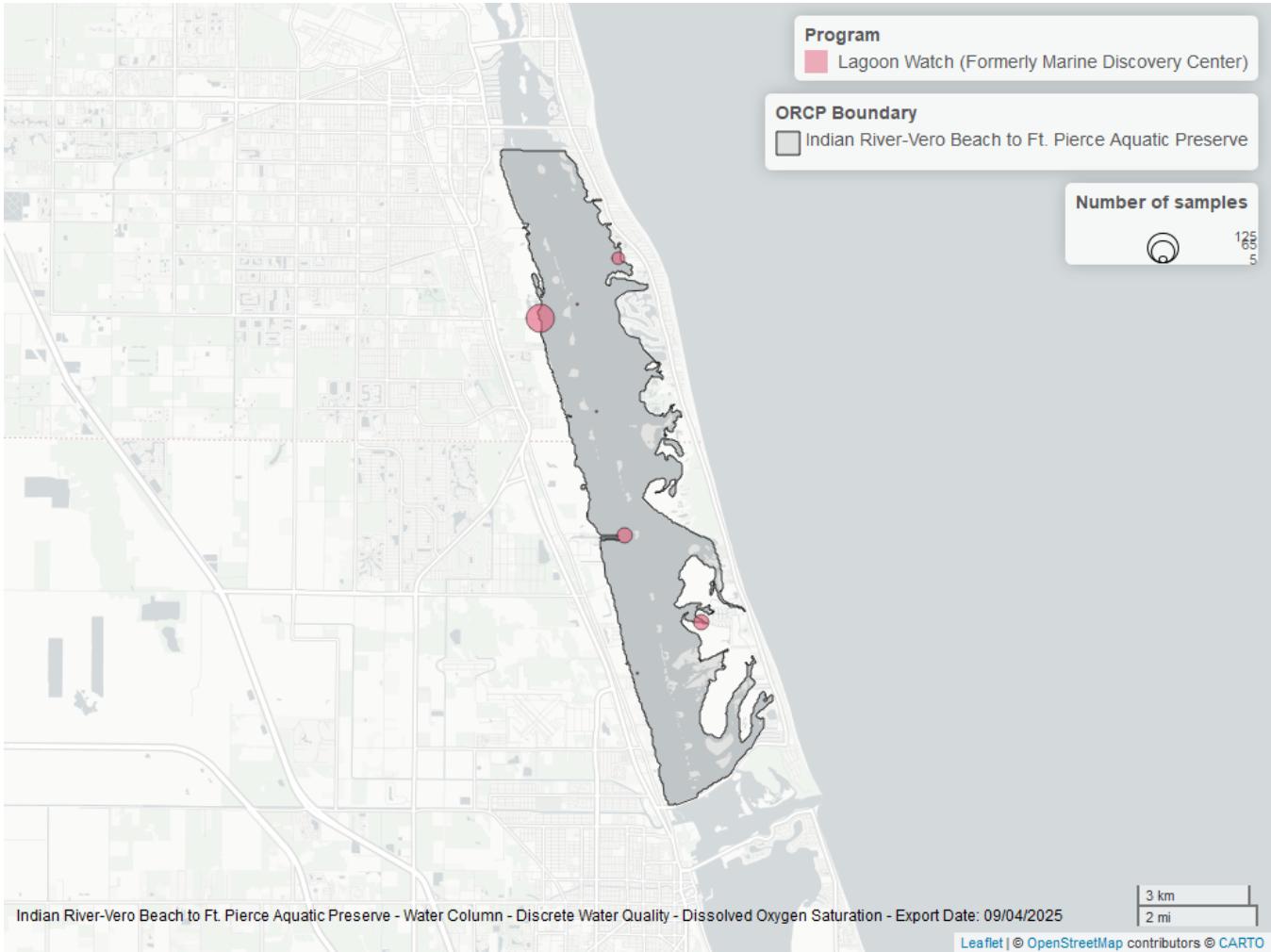


Figure 10: Map showing location of discrete water quality sampling locations within the boundaries of *Indian River-Vero Beach to Ft. Pierce Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 15: Programs contributing data for Dissolved Oxygen Saturation

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
5002	444	1996	2025
3001	220	1992	2023
3013	200	2012	2024

Program names:

3001 - Lagoon Watch (Formerly Marine Discovery Center)⁸

3013 - Seagrass (SJRWMD)⁹

5002 - Florida STORET / WIN²

pH - Discrete

Seasonal Kendall-Tau Trend Analysis

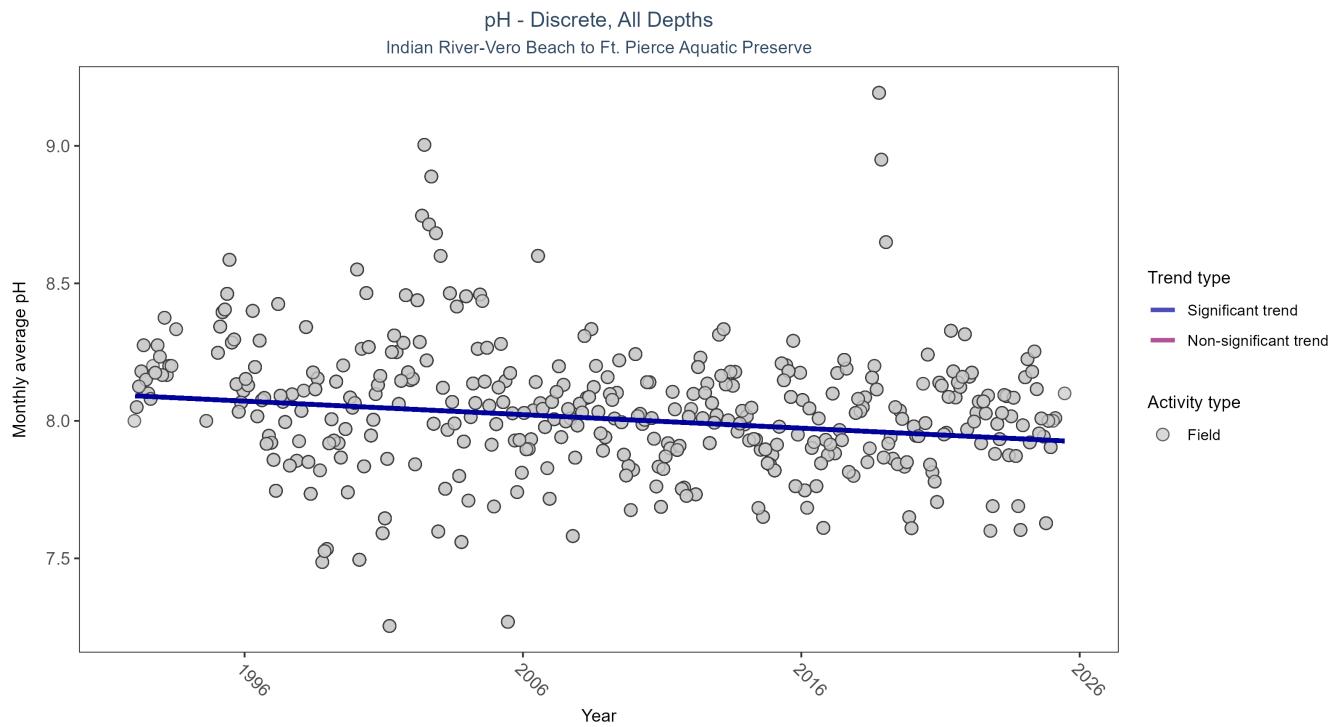


Figure 11: Scatter plot of monthly average pH over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only pH values measured in the field (circles) are included in the plot.

Table 16: Seasonal Kendall-Tau Trend Analysis for pH

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Field	Significantly decreasing trend	6055	34	1992 - 2025	8.02	-0.1482	8.0915	-0.0049	0

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

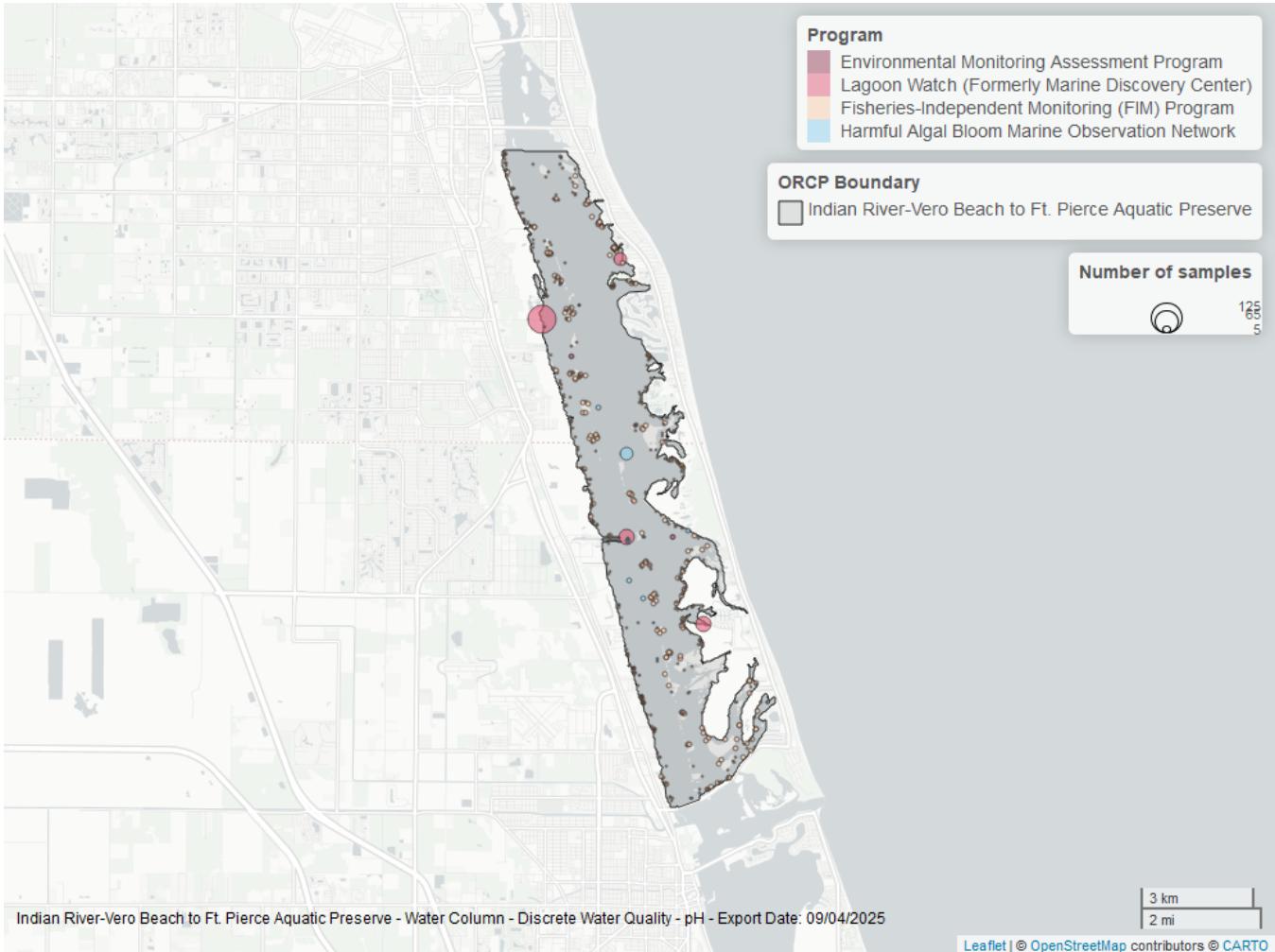


Figure 12: Map showing location of discrete water quality sampling locations within the boundaries of *Indian River-Vero Beach to Ft. Pierce Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 17: Programs contributing data for pH

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
5002	4154	1995	2025
69	1310	1998	2024
3013	388	2003	2024
3001	224	1992	2023
95	60	2002	2018
540	48	2016	2020
115	6	1994	1995

Program names:

- 69 - Fisheries-Independent Monitoring (FIM) Program⁵
- 95 - Harmful Algal Bloom Marine Observation Network⁶
- 115 - Environmental Monitoring Assessment Program⁷
- 540 - Shellfish Harvest Area Classification Program¹
- 3001 - Lagoon Watch (Formerly Marine Discovery Center)⁸

3013 - Seagrass (SJRWM)⁹
 5002 - Florida STORET / WIN²

Salinity - Discrete

Seasonal Kendall-Tau Trend Analysis

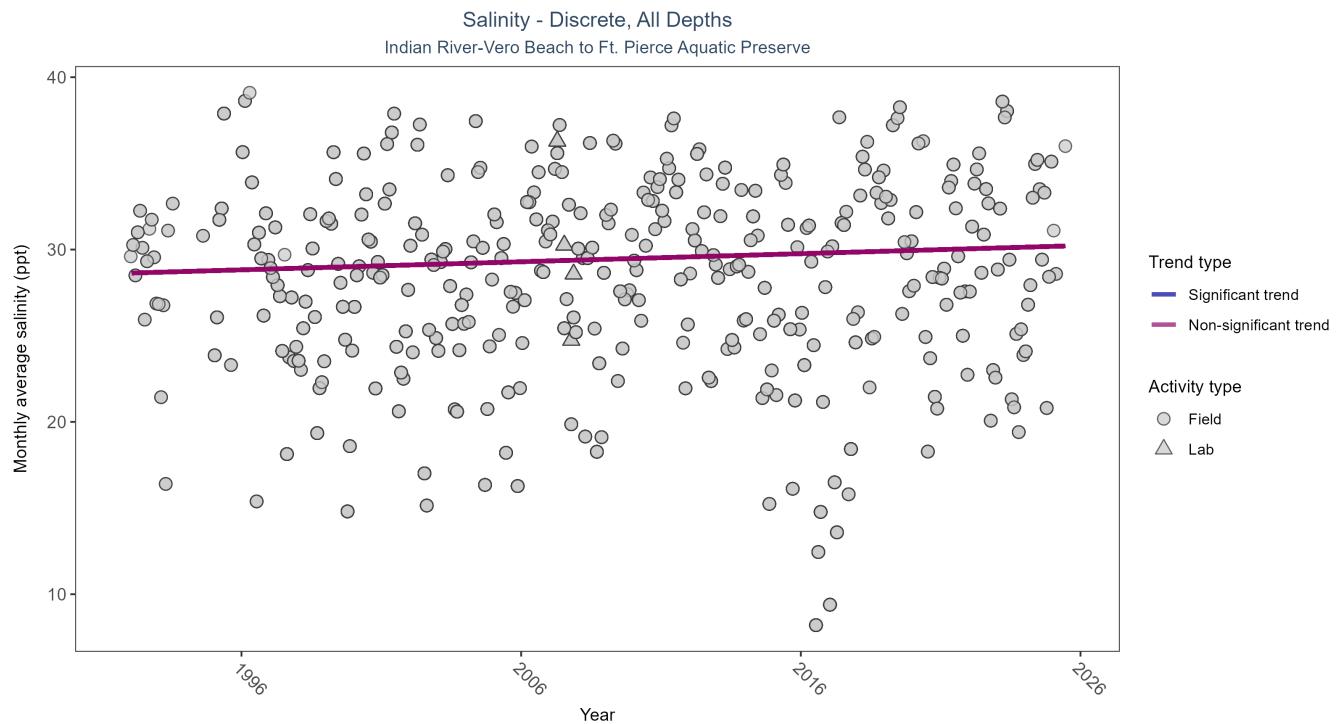


Figure 13: Scatter plot of monthly average salinity over time. If the time series included ten or more years of discrete observations, significant (blue) or non-significant (magenta) trend lines are also shown. Discrete salinity values derived from grab samples analyzed in the field (circles) or the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

Table 18: Seasonal Kendall-Tau Trend Analysis for Salinity

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
All	No significant trend	8801	34	1992 - 2025	29.1	0.0656	28.6343	0.047	0.0699

Salinity showed no detectable trend between 1992 and 2025.

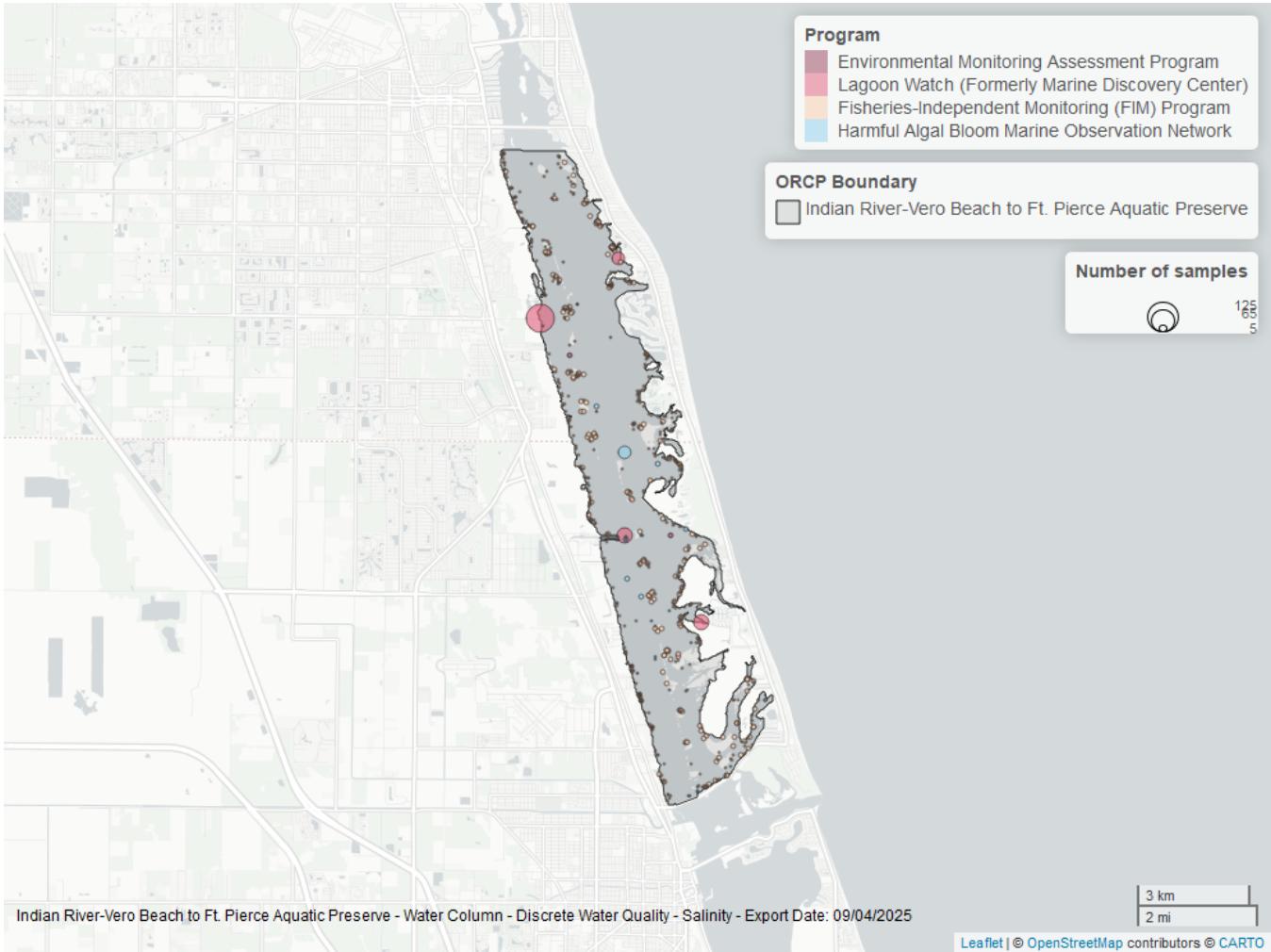


Figure 14: Map showing location of discrete water quality sampling locations within the boundaries of *Indian River-Vero Beach to Ft. Pierce Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 19: Programs contributing data for Salinity

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
5002	6639	1995	2025
69	1418	1997	2024
3013	390	2003	2024
3001	222	1992	2023
95	76	1996	2018
540	60	2016	2020
115	7	1994	1995

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program⁵

95 - Harmful Algal Bloom Marine Observation Network⁶

115 - Environmental Monitoring Assessment Program⁷

540 - Shellfish Harvest Area Classification Program¹

3001 - Lagoon Watch (Formerly Marine Discovery Center)⁸

3013 - Seagrass (SJRWM)⁹
 5002 - Florida STORET / WIN²

Secchi Depth - Discrete

Seasonal Kendall-Tau Trend Analysis

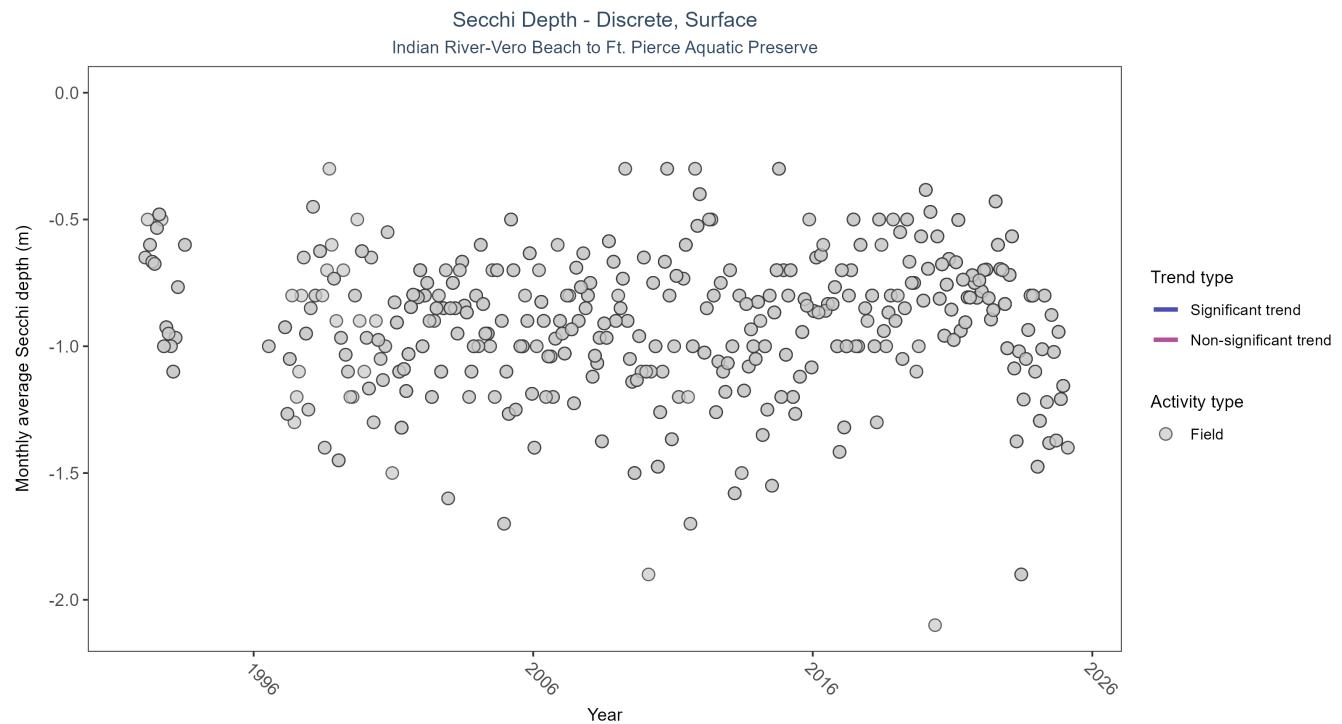


Figure 15: Scatter plot of monthly average Secchi depth over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Secchi depth is only measured in the field (circles).

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

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Field	No significant trend	2275	32	1992 - 2025	-0.9	-0.0081	-0.9164	0	0.8205

Secchi depth showed no detectable trend between 1992 and 2025.

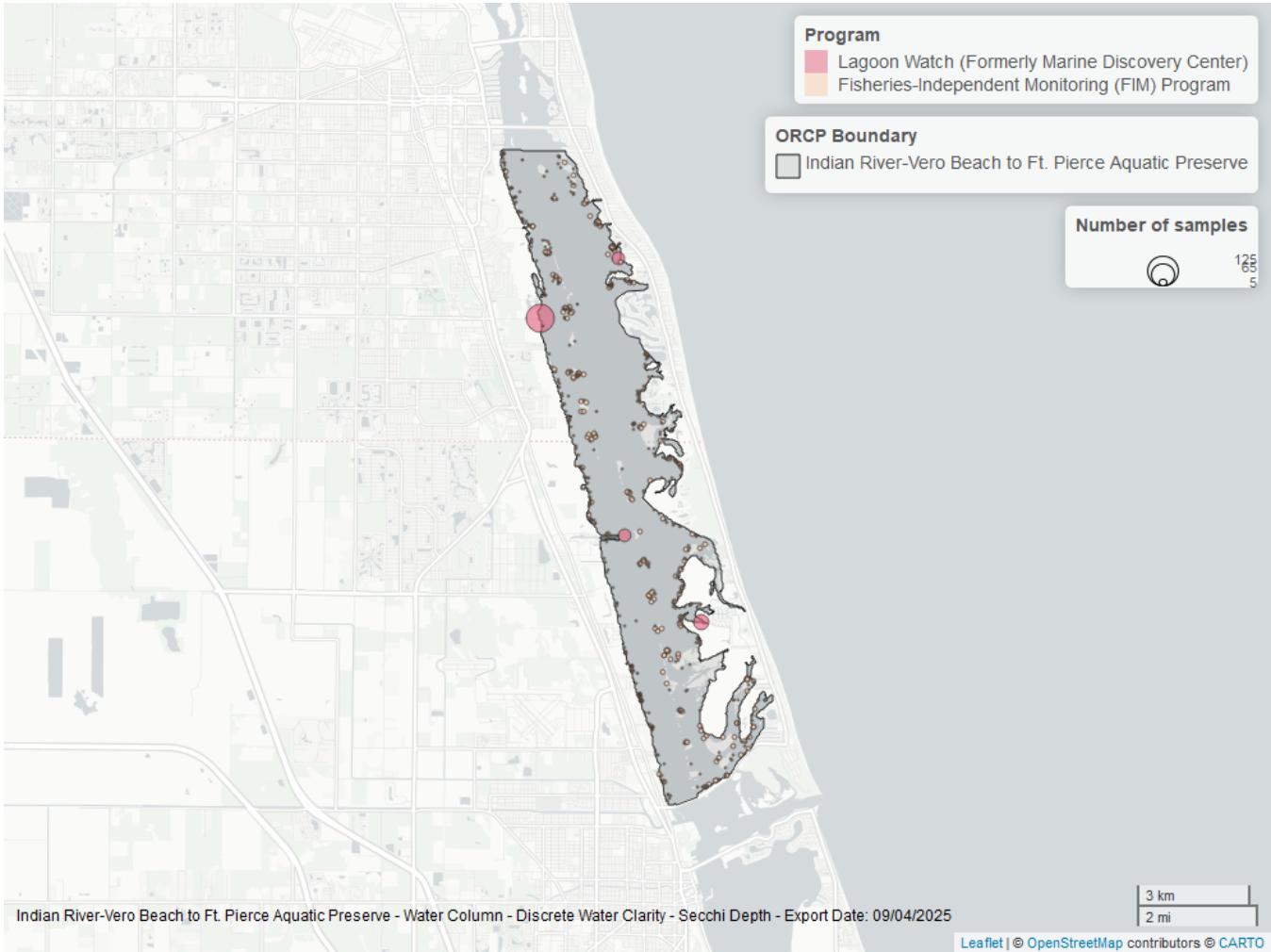


Figure 16: Map showing location of discrete water quality sampling locations within the boundaries of *Indian River-Vero Beach to Ft. Pierce Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 21: Programs contributing data for Secchi Depth

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
69	1420	1997	2024
3013	383	2003	2024
5002	268	2007	2025
3001	209	1992	2023

Program names:

- 69 - Fisheries-Independent Monitoring (FIM) Program⁵
- 3001 - Lagoon Watch (Formerly Marine Discovery Center)⁸
- 3013 - Seagrass (SJRWMD)⁹
- 5002 - Florida STORET / WIN²

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

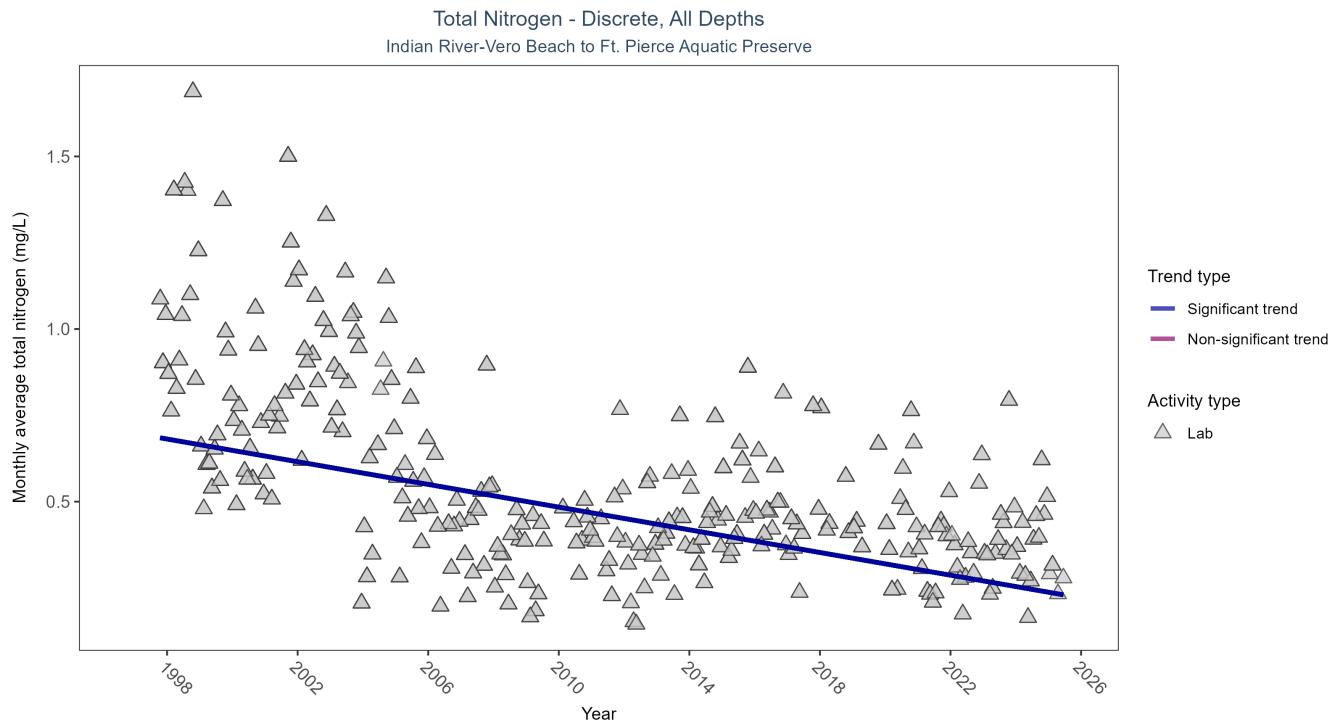


Figure 17: Scatter plot of monthly average total nitrogen over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only nitrogen values obtained from laboratory analyses (triangles) are included in the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

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

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Lab	Significantly decreasing trend	1053	29	1997 - 2025	0.521	-0.4311	0.6978	-0.0164	0

Monthly average total nitrogen decreased by 0.02 mg/L per year.

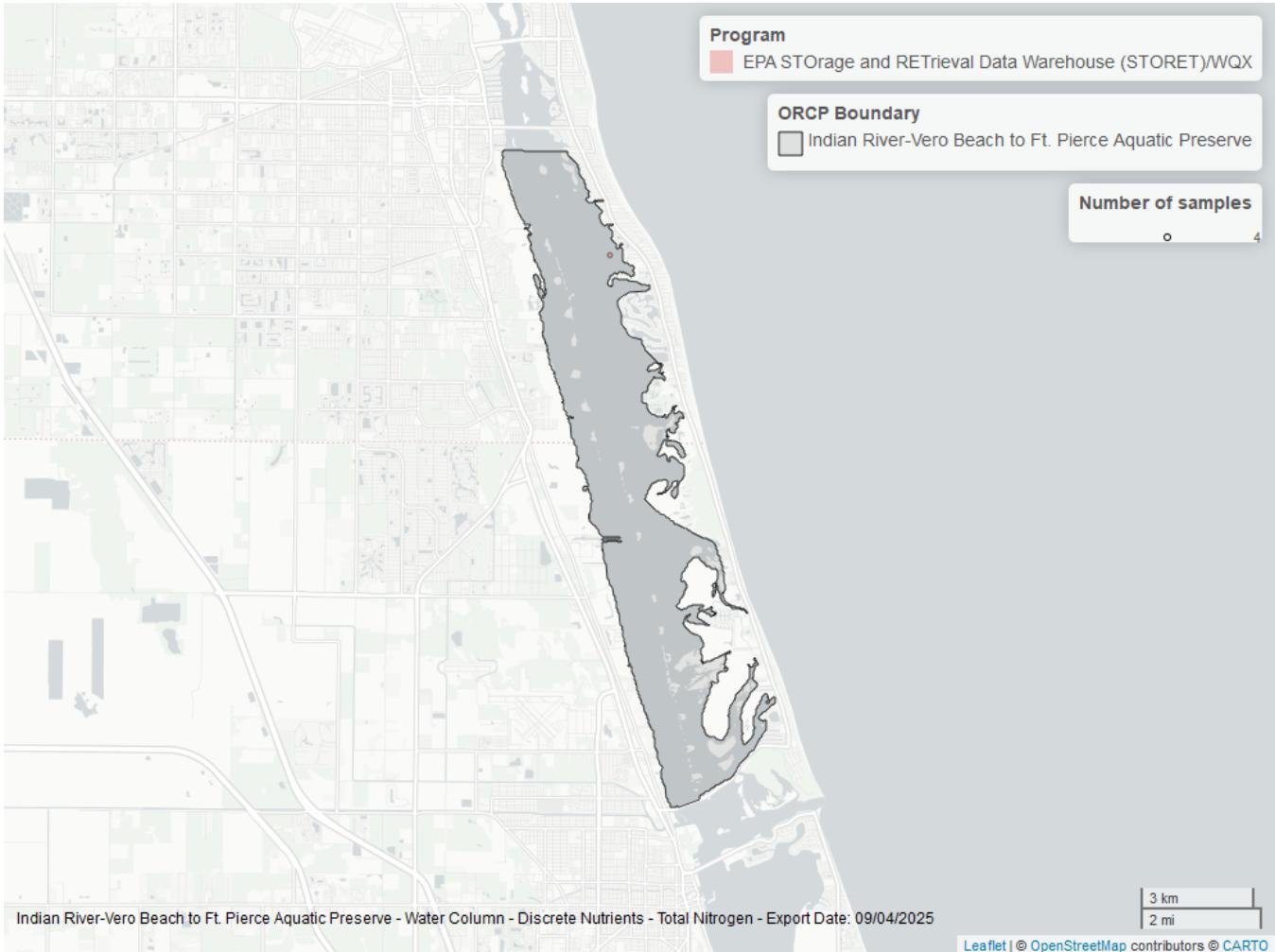


Figure 18: Map showing location of discrete water quality sampling locations within the boundaries of *Indian River-Vero Beach to Ft. Pierce Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 23: Programs contributing data for Total Nitrogen

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
5002	989	1997	2025
540	60	2016	2020
103	4	2006	2006

Program names:

- 103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX³
- 540 - Shellfish Harvest Area Classification Program¹
- 5002 - Florida STORET / WIN²

Total Phosphorus - Discrete

Seasonal Kendall-Tau Trend Analysis

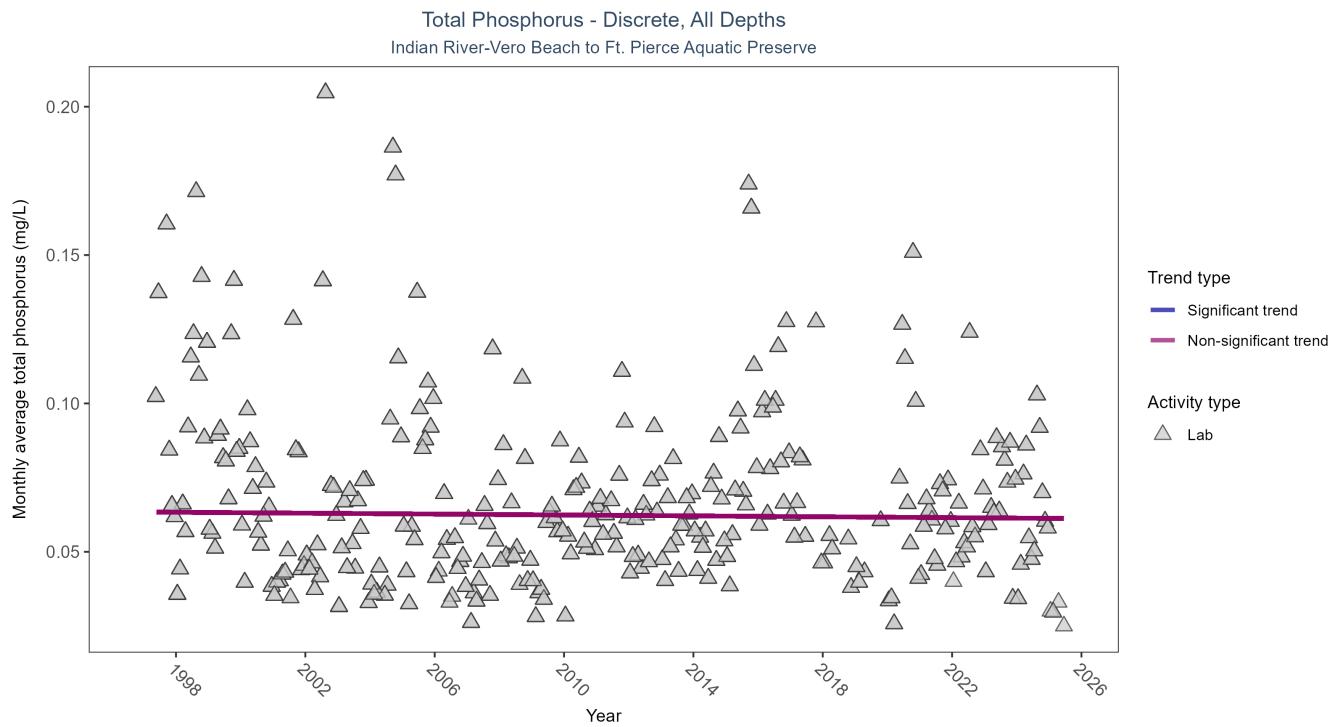


Figure 19: Scatter plot of monthly average total phosphorus over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only phosphorus values obtained from laboratory analyses (triangles) are included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

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

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Lab	No significant trend	2125	29	1997 - 2025	0.06	-0.0243	0.0634	-0.0001	0.5434

Total phosphorus showed no detectable trend between 1997 and 2025.

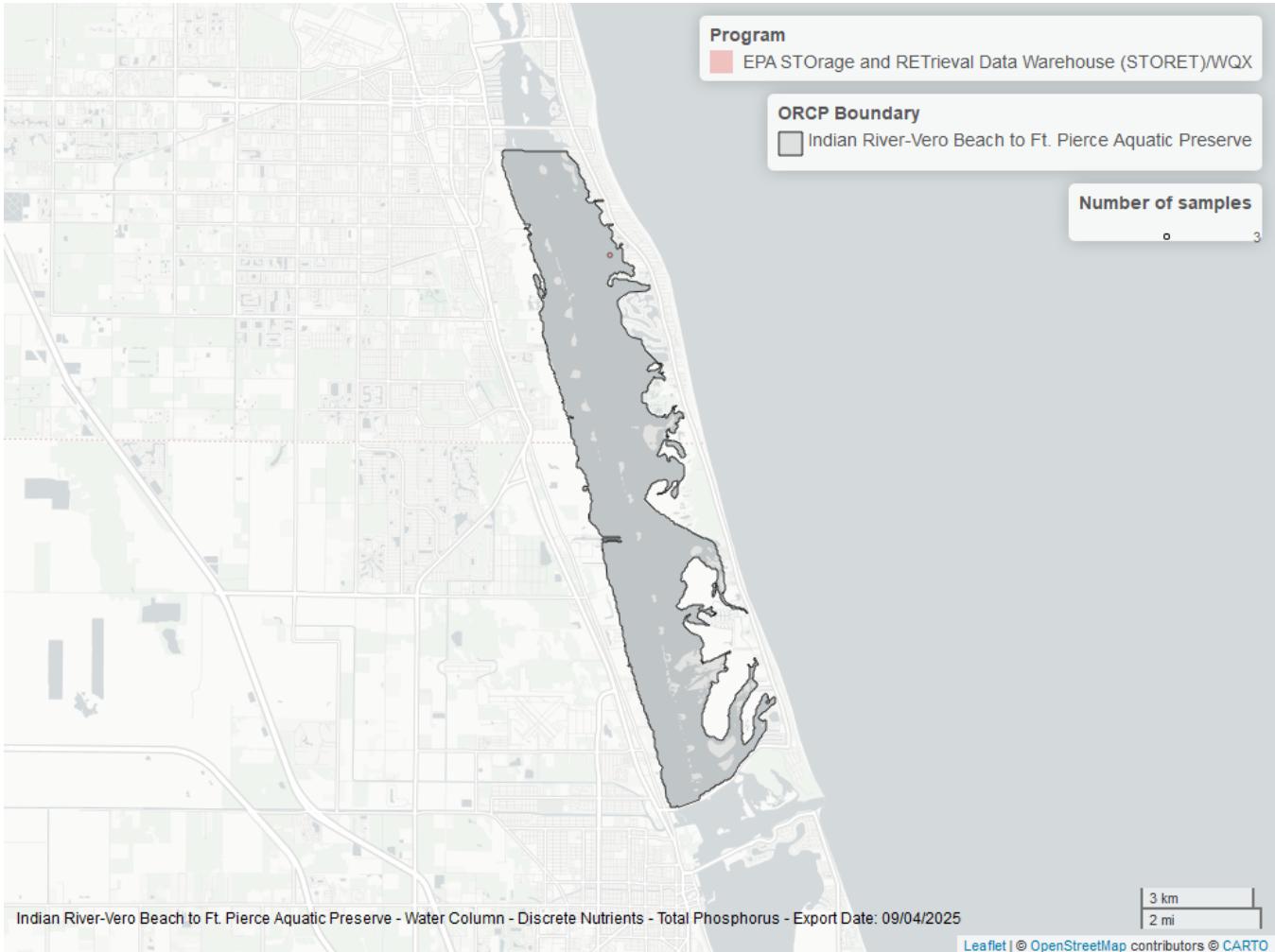


Figure 20: Map showing location of discrete water quality sampling locations within the boundaries of *Indian River-Vero Beach to Ft. Pierce Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 25: Programs contributing data for Total Phosphorus

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
5002	2136	1997	2025
540	60	2016	2020
103	3	2006	2006

Program names:

- 103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX³
- 540 - Shellfish Harvest Area Classification Program¹
- 5002 - Florida STORET / WIN²

Total Suspended Solids - Discrete

Seasonal Kendall-Tau Trend Analysis

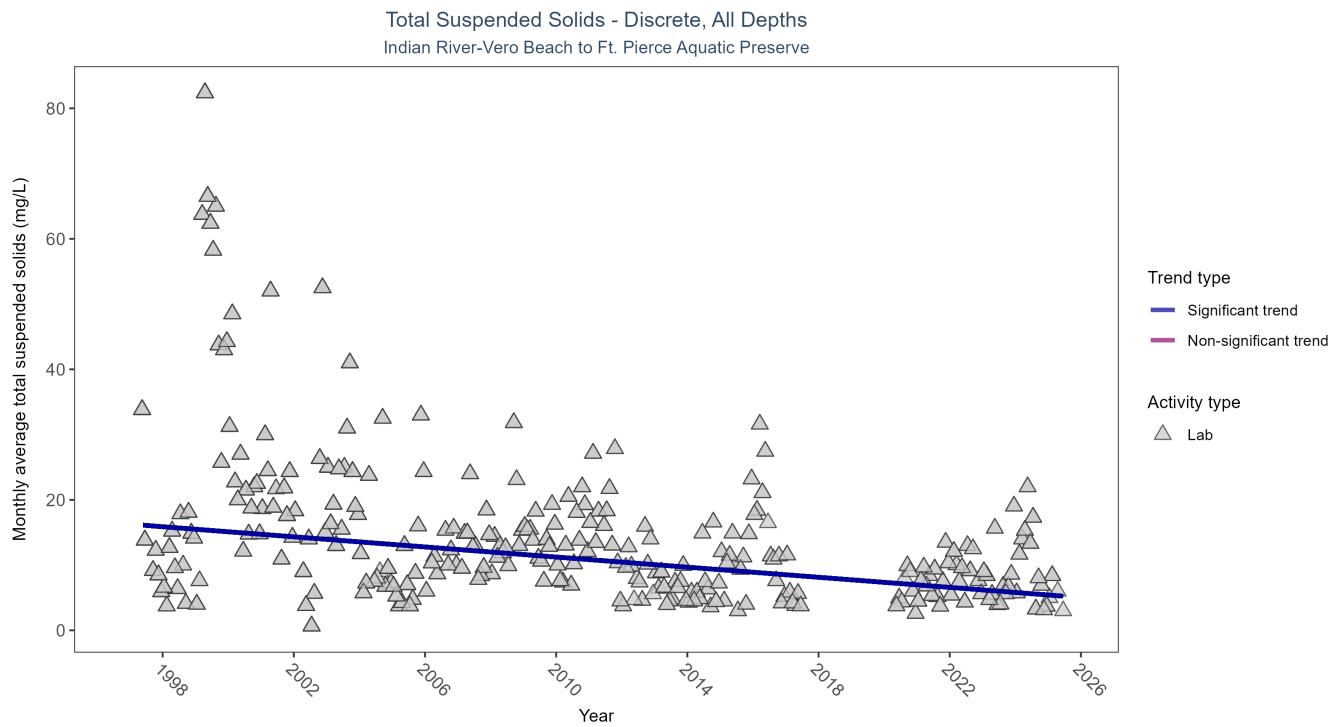


Figure 21: Scatter plot of monthly average total suspended solids (TSS) over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only TSS values obtained from laboratory analyses (triangles) are included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

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

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Lab	Significantly decreasing trend	912	27	1997 - 2025	12	-0.3049	16.2683	-0.3875	0

Monthly average total suspended solids decreased by 0.39 mg/L per year, indicating an increase in water clarity.

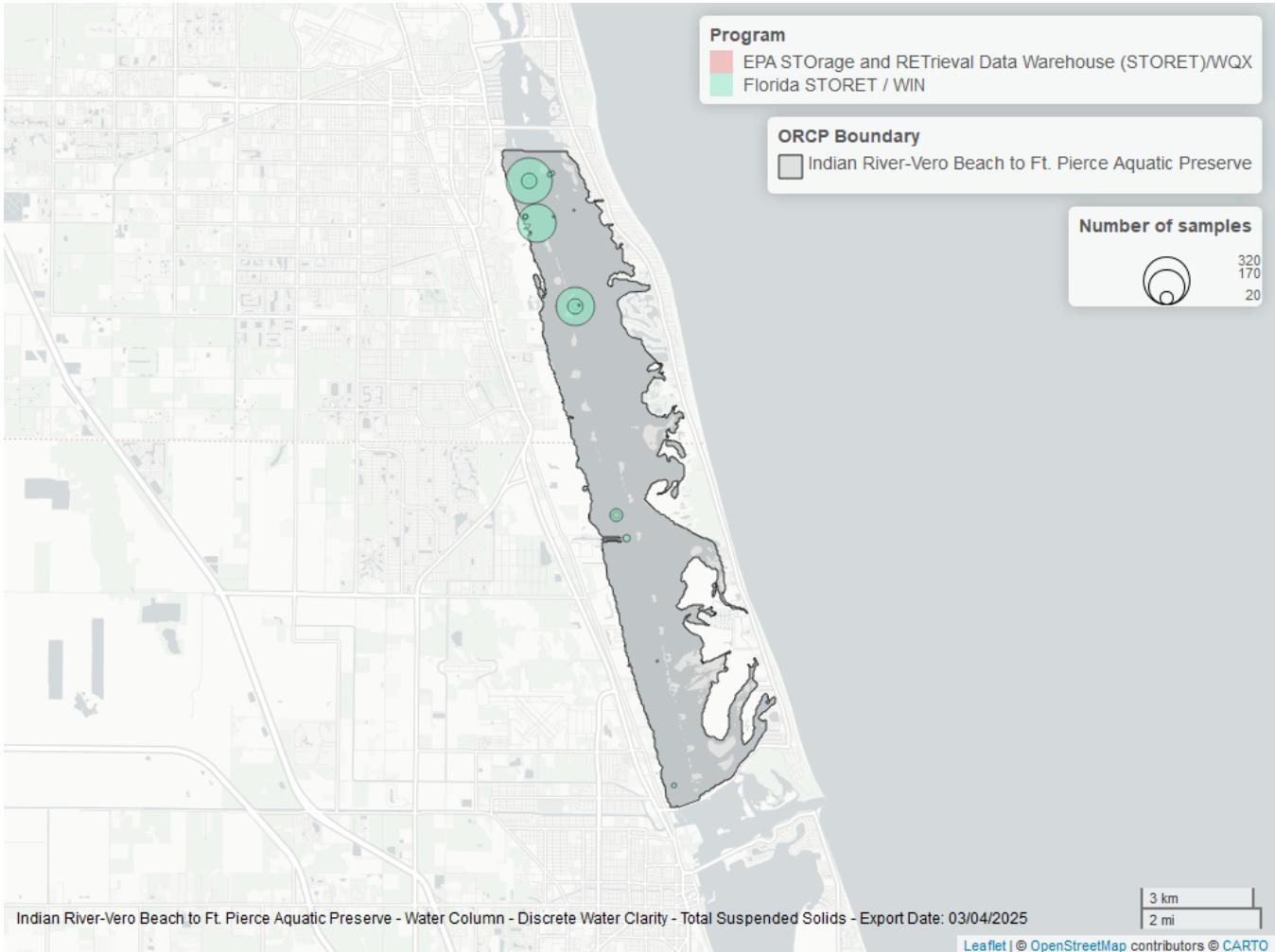


Figure 22: Map showing location of discrete water quality sampling locations within the boundaries of *Indian River-Vero Beach to Ft. Pierce Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 27: Programs contributing data for Total Suspended Solids

ProgramID	N_Data	YearMin	YearMax
5002	945	1997	2025

Program names:

5002 - Florida STORET / WIN²

Turbidity - Discrete

Seasonal Kendall-Tau Trend Analysis

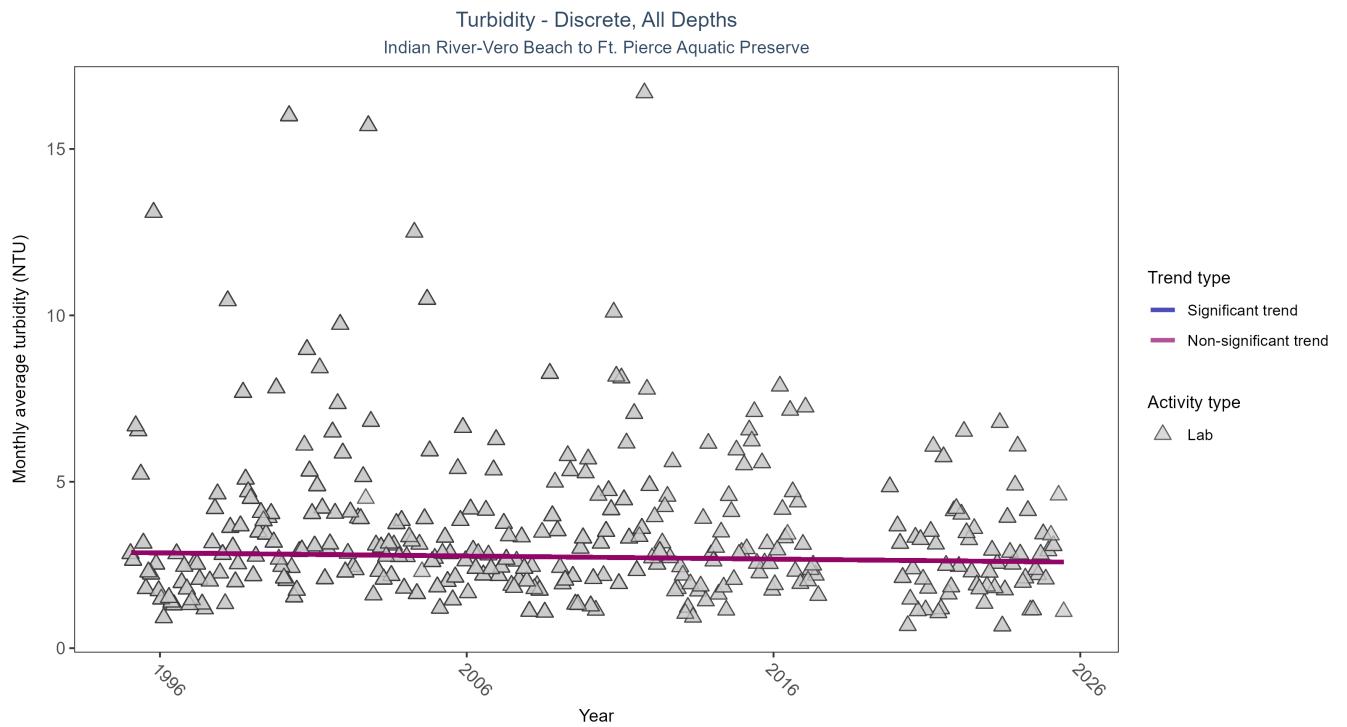


Figure 23: Scatter plot of monthly average turbidity over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only turbidity values measured in the laboratory (triangles) are included in the plot.

Table 28: Seasonal Kendall-Tau Trend Analysis for Turbidity

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Lab	No significant trend	3980	30	1995 - 2025	2.6	-0.0387	2.8721	-0.0093	0.3689

Turbidity showed no detectable trend between 1995 and 2025.

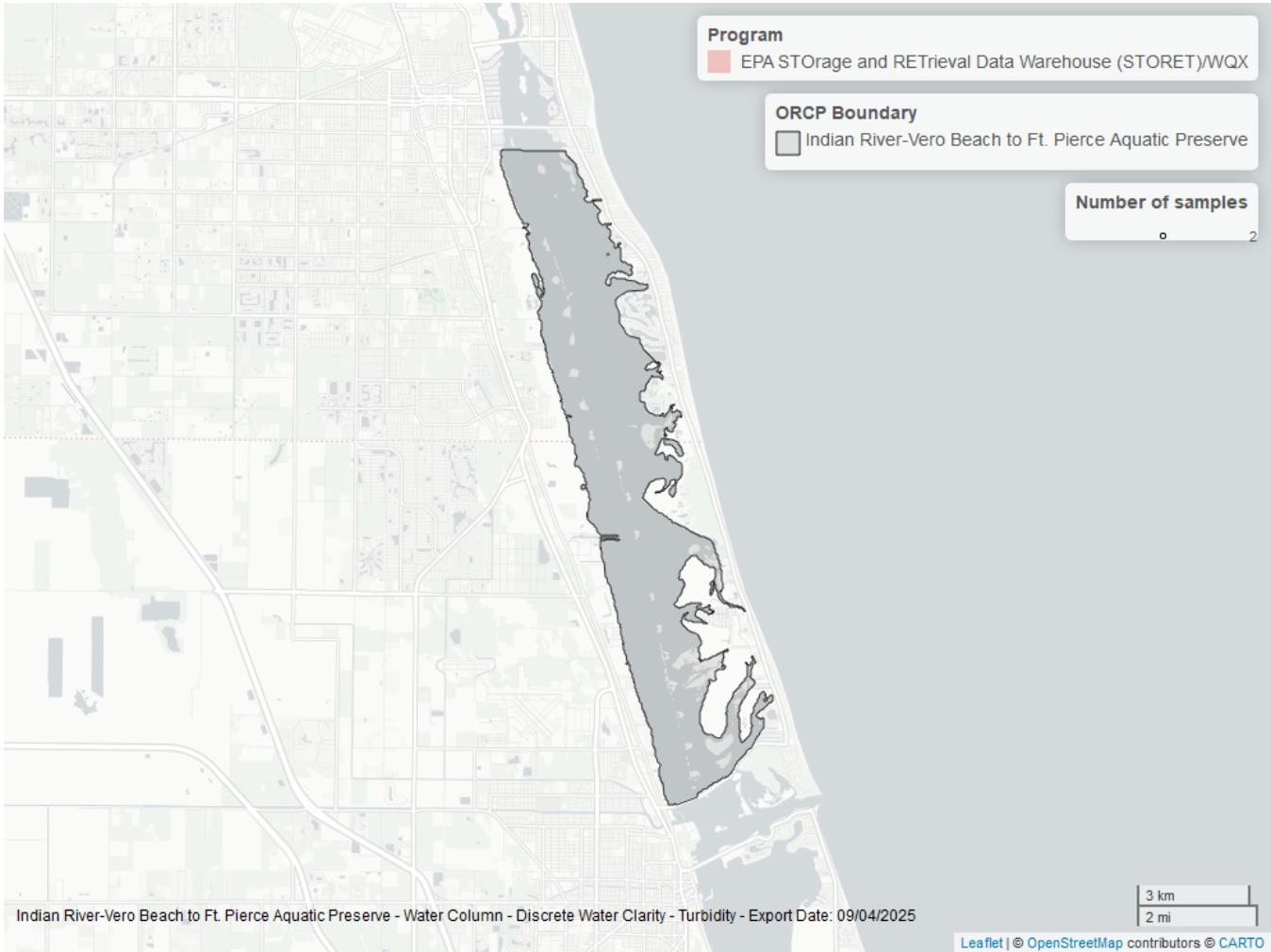


Figure 24: Map showing location of discrete water quality sampling locations within the boundaries of *Indian River-Vero Beach to Ft. Pierce Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 29: Programs contributing data for Turbidity

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
5002	4014	1995	2025
3013	304	2004	2019
540	17	2019	2020
103	2	2006	2006

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX³

540 - Shellfish Harvest Area Classification Program¹

3013 - Seagrass (SJRWMD)⁹

5002 - Florida STORET / WIN²

Water Temperature - Discrete

Seasonal Kendall-Tau Trend Analysis

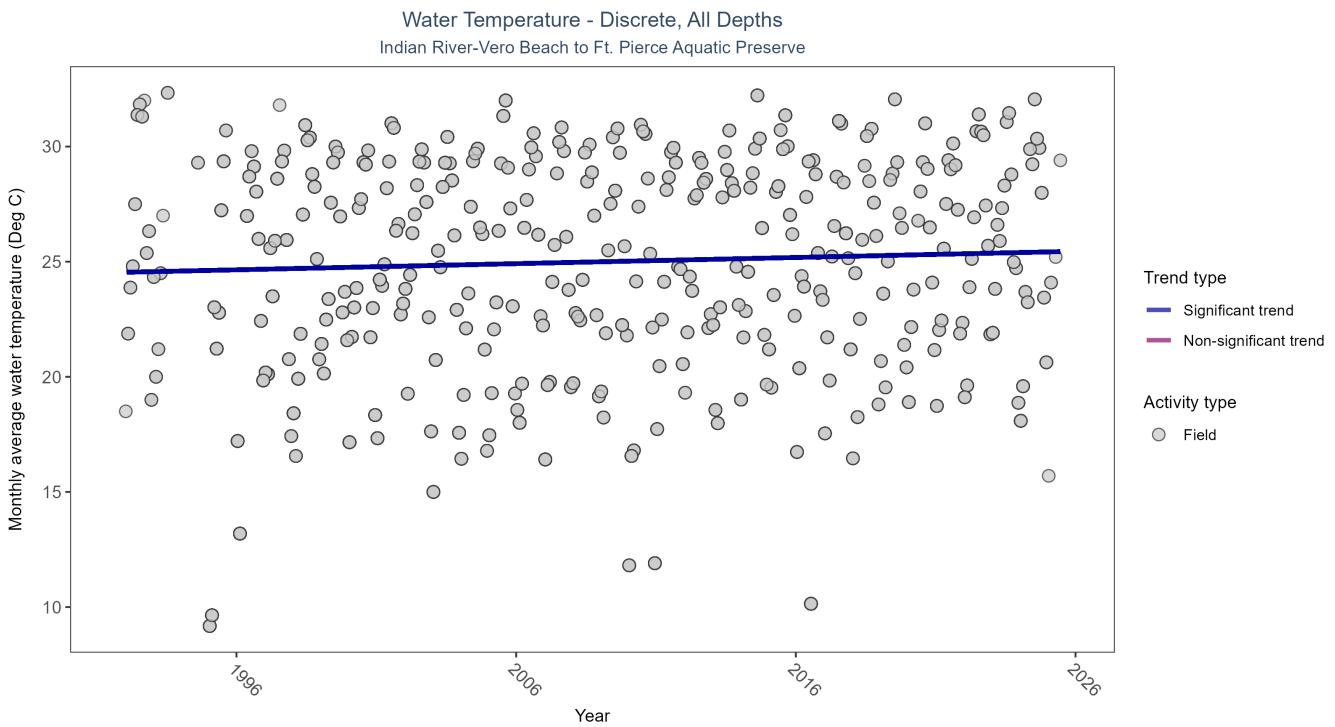


Figure 25: Scatter plot of monthly average water temperature over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only water temperature measurements taken in the field (circles) are included in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

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

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Field	Significantly increasing trend	8809	34	1992 - 2025	25.5	0.1294	24.5397	0.0268	0.0004

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

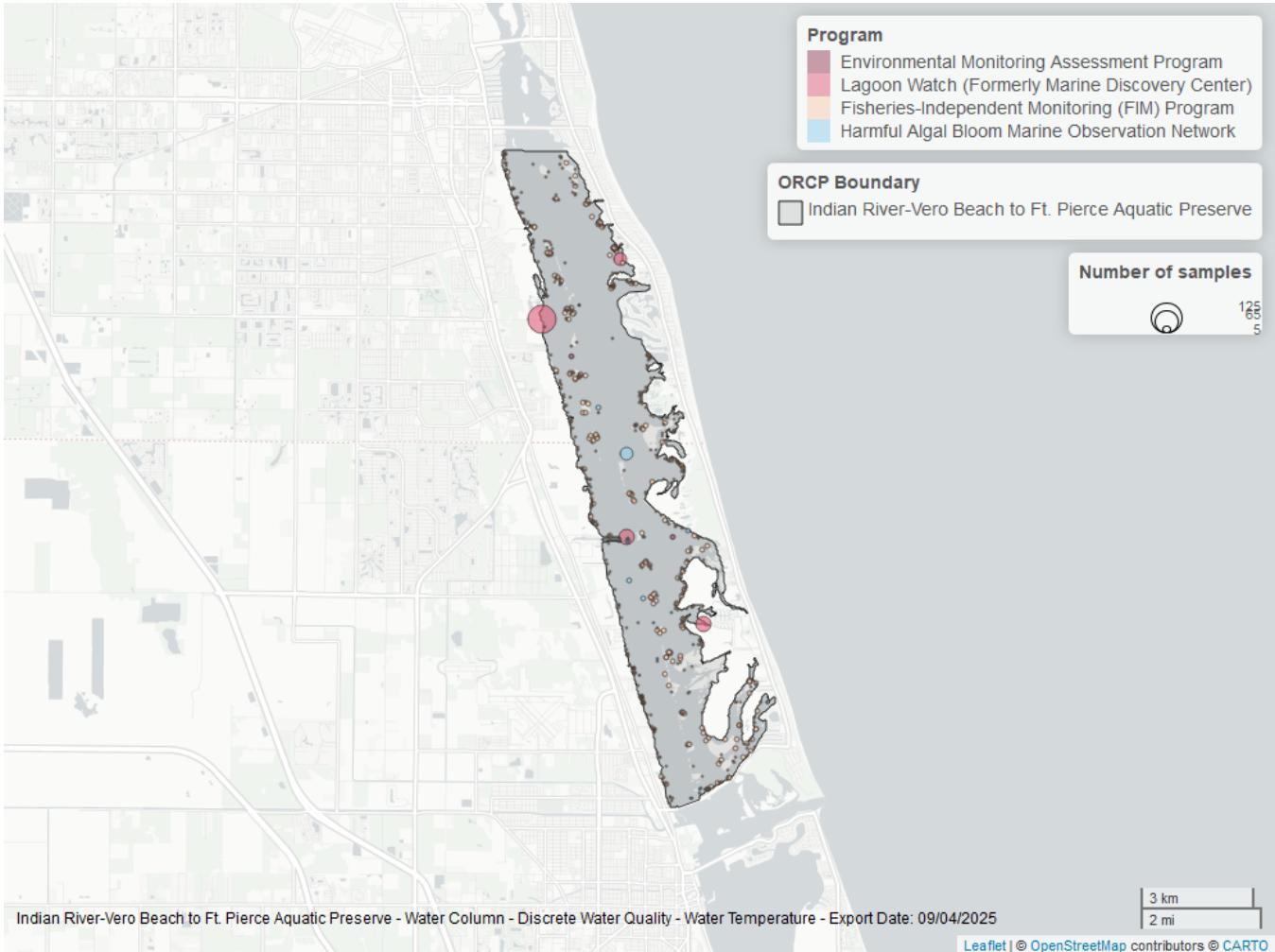


Figure 26: Map showing location of discrete water quality sampling locations within the boundaries of *Indian River-Vero Beach to Ft. Pierce Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 31: Programs contributing data for Water Temperature

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
5002	6764	1995	2025
69	1418	1997	2024
3013	390	1999	2024
3001	224	1992	2023
95	72	1996	2018
540	60	2016	2020
115	7	1994	1995

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program⁵

95 - Harmful Algal Bloom Marine Observation Network⁶

115 - Environmental Monitoring Assessment Program⁷

540 - Shellfish Harvest Area Classification Program¹

3001 - Lagoon Watch (Formerly Marine Discovery Center)⁸

3013 - Seagrass (SJRWMD)⁹
5002 - Florida STORET / WIN²

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

Indian River-Vero Beach to Ft. Pierce Aquatic Preserve
SAV Percent Cover - Sample Locations

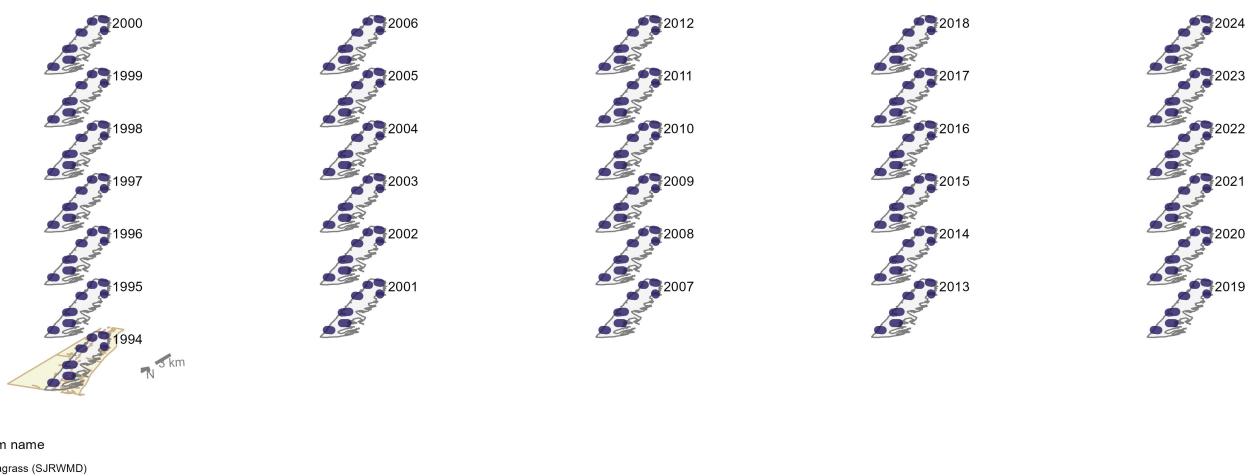


Figure 27: Maps showing the temporal scope of SAV sampling sites within the boundaries of *Indian River-Vero Beach to Ft. Pierce Aquatic Preserve* by Program name.

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

Sampling locations by Program:

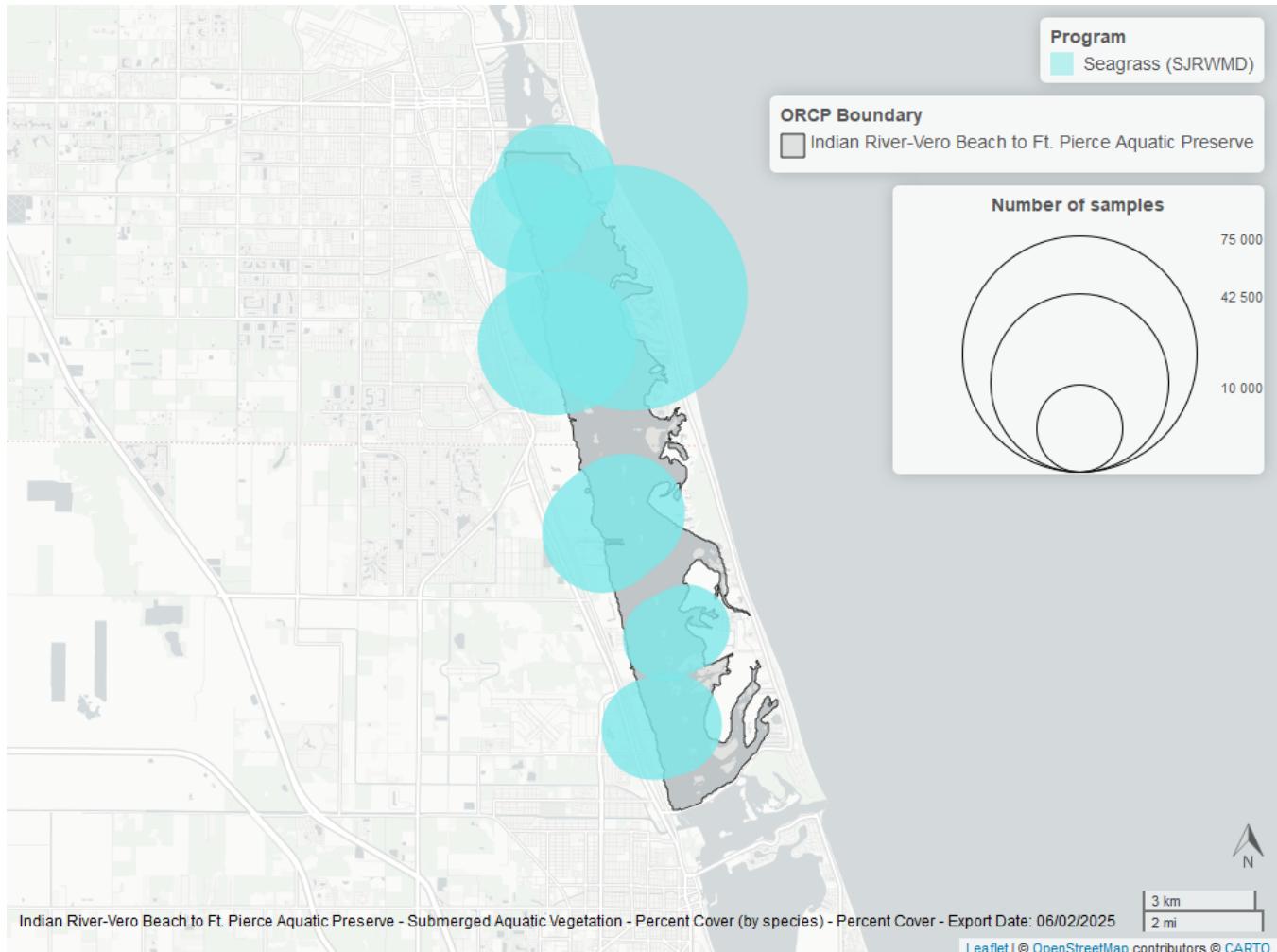


Figure 28: Map showing SAV sampling sites within the boundaries of *Indian River-Vero Beach to Ft. Pierce Aquatic Preserve*. The point size reflects the number of samples at a given sampling site.

Table 32: Program Information for Submerged Aquatic Vegetation

ProgramID	N-Data	YearMin	YearMax	method	Sample Locations
3013	50856	1994	2024	Percent Cover	7
3013	60178	1994	2024	Percent Occurrence	7

Program names:

3013 - Seagrass (SJRWMD)⁹
3013 - Seagrass (SJRWMD)⁹

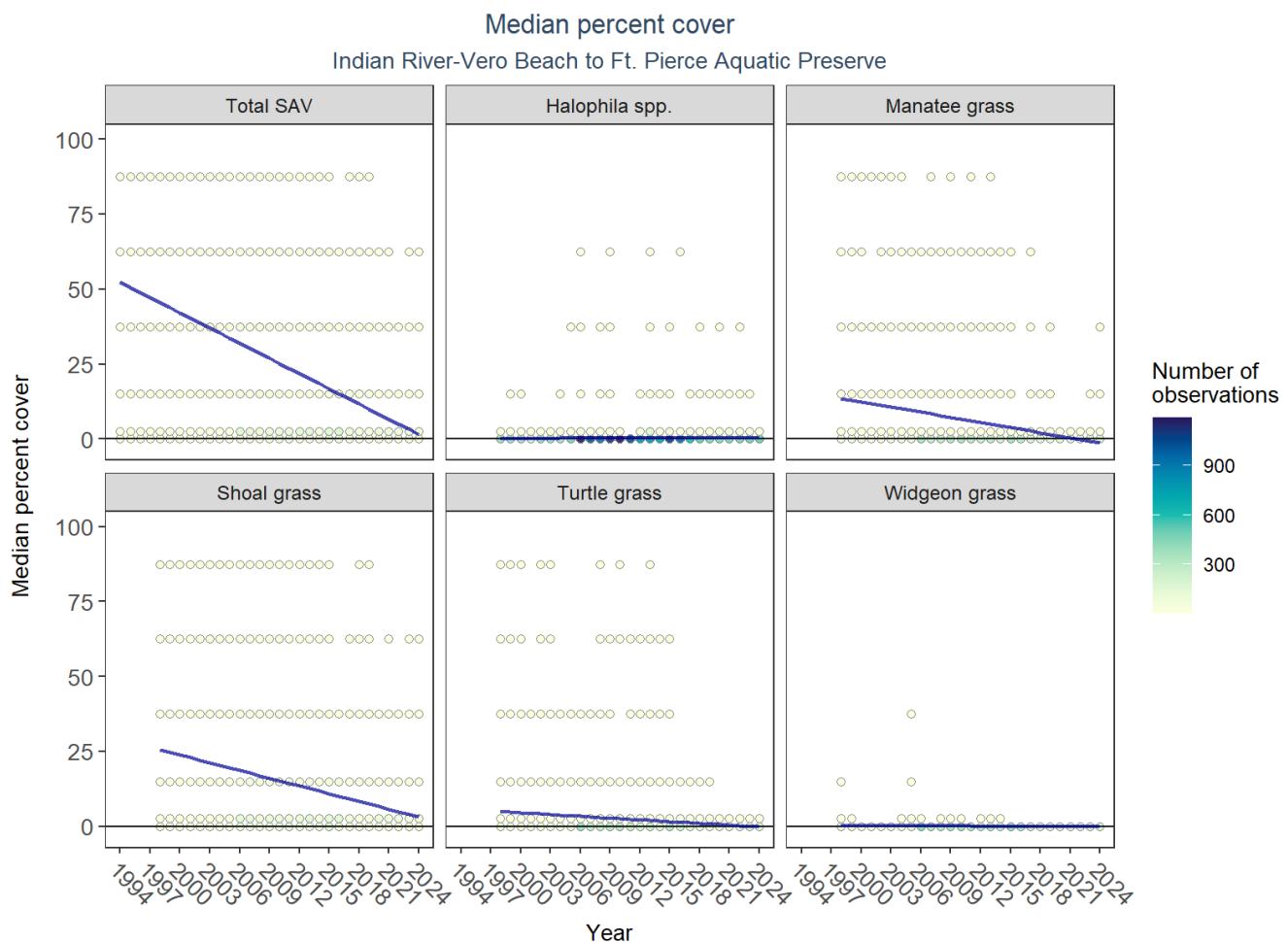


Figure 29: Scatter plots of median percent cover of submerged aquatic vegetation over time by group. Plots for time series that included five or more years of observations show the estimated trend as a blue line.

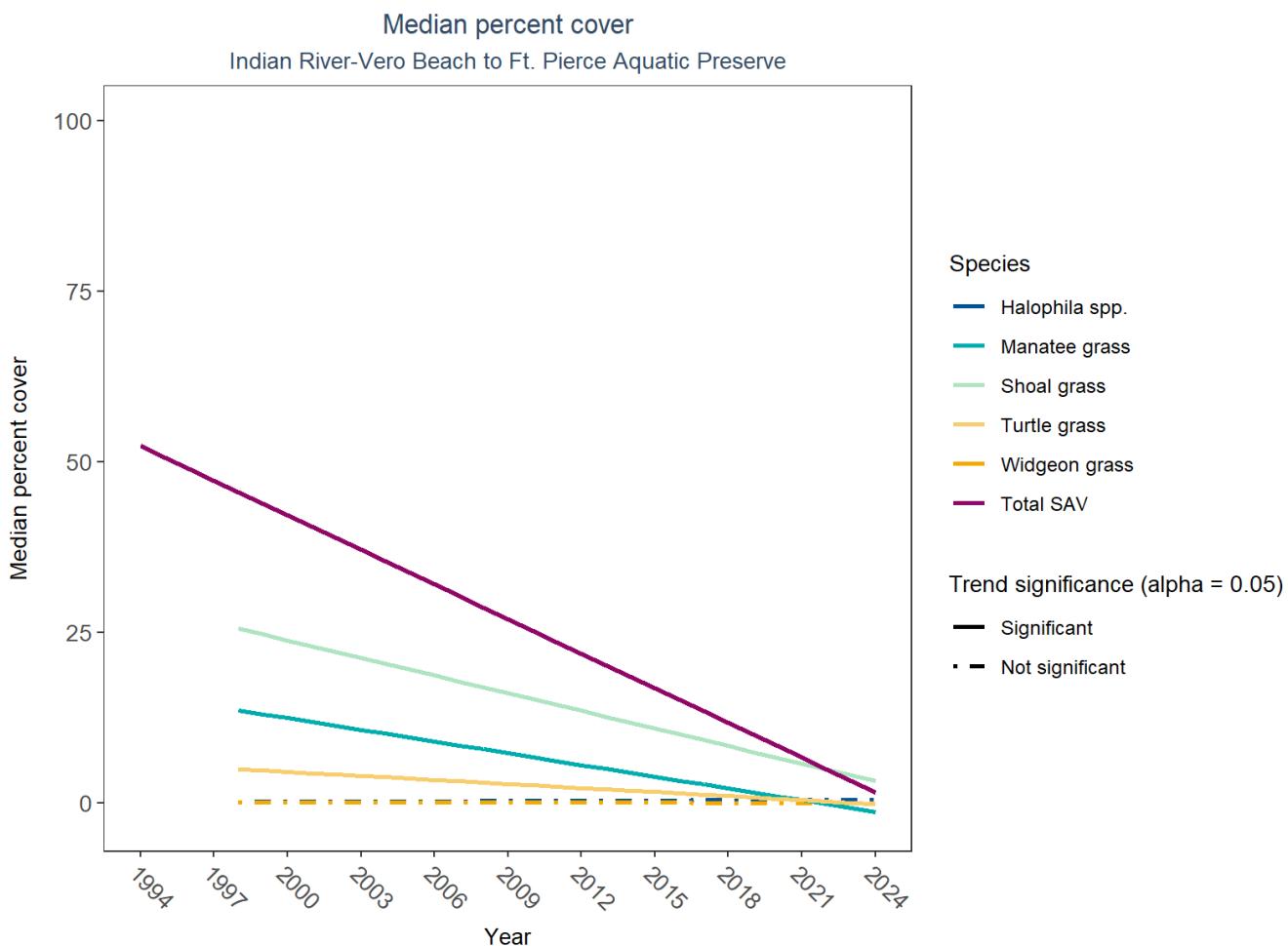


Figure 30: Trends in median percent cover for various seagrass species in Indian River-Vero Beach to Ft. Pierce Aquatic Preserve - simplified

Table 33: Percent Cover Trend Analysis for Indian River-Vero Beach to Ft. Pierce Aquatic Preserve

Common Name	Trend Significance (0.05)	Period of Record	LME-Intercept	LME-Slope	p
Drift algae	Insufficient data to calculate trend	-	-	-	-
Shoal grass	Significantly decreasing trend	1998 - 2024	28.9769326	-0.8607224	0.0004655
Halophila spp.	No significant trend	1998 - 2024	0.0856621	0.0127948	0.0511908
Widgeon grass	No significant trend	1998 - 2024	0.1321843	-0.0051250	0.1184987
Manatee grass	Significantly decreasing trend	1998 - 2024	15.8420696	-0.5722262	0.0419865
Turtle grass	Significantly decreasing trend	1998 - 2024	5.7156583	-0.1968309	0.0148175
Total SAV	Significantly decreasing trend	1994 - 2024	52.3021115	-1.6915102	0.0000000
Total seagrass	Insufficient data to calculate trend	-	-	-	-

Annual decreases in percent cover were observed for total SAV (-1.7%), manatee grass (-0.6%), shoal grass (-0.9%), and turtle grass (-0.2%). No detectable change in percent cover was observed for *Halophila* spp. and widgeon grass. Trends in percent cover could not be evaluated for total seagrass and drift algae due to insufficient data.

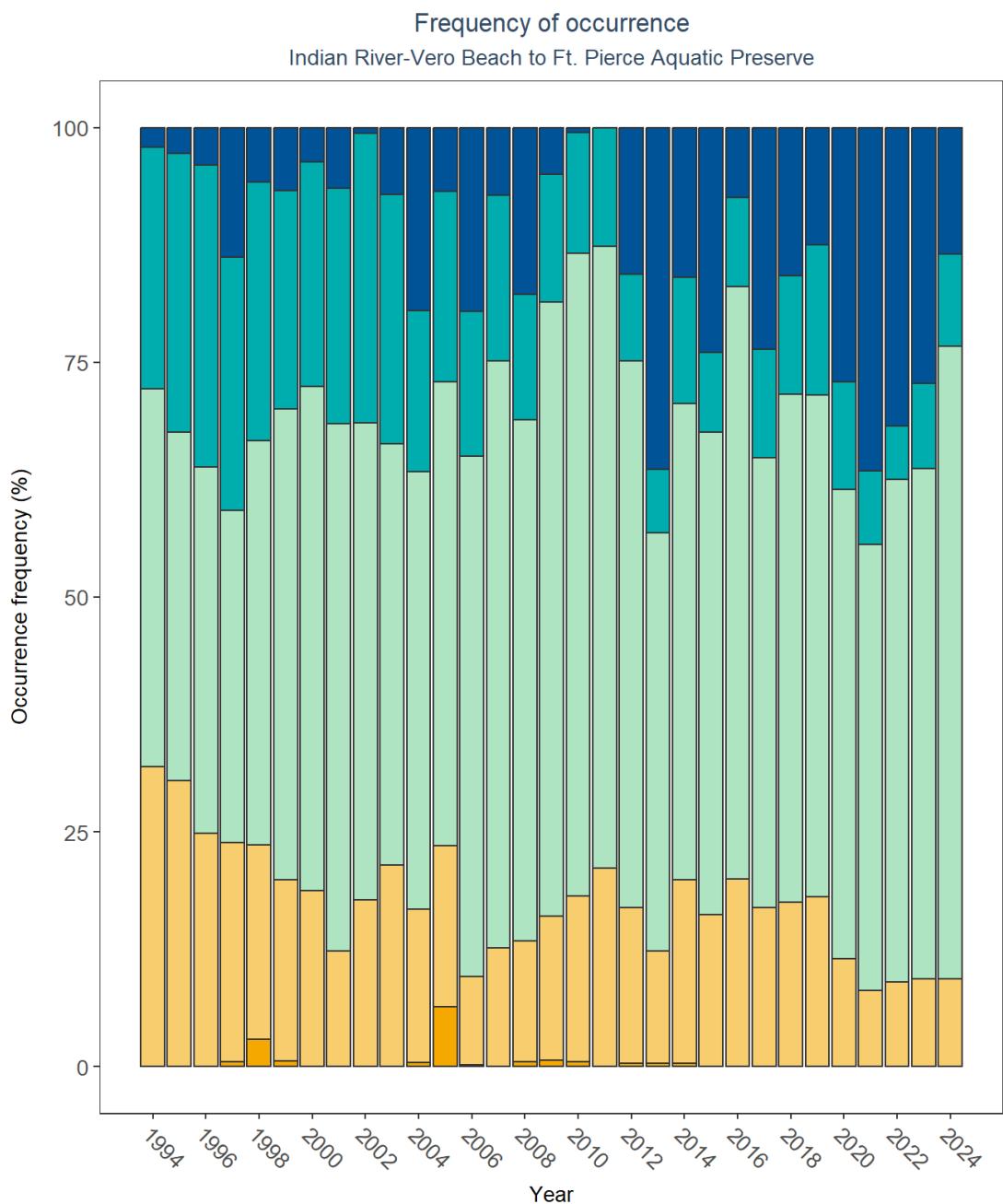


Figure 31: Frequency of occurrence for various seagrass species in Indian River-Vero Beach to Ft. Pierce Aquatic Preserve

SAV Water Column Analysis

The following parameters are available for Indian River-Vero Beach to Ft. Pierce Aquatic Preserve within the SAV_WC_Report:

- Colored Dissolved Organic Matter
- 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](#)

Oyster

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

Density

Natural

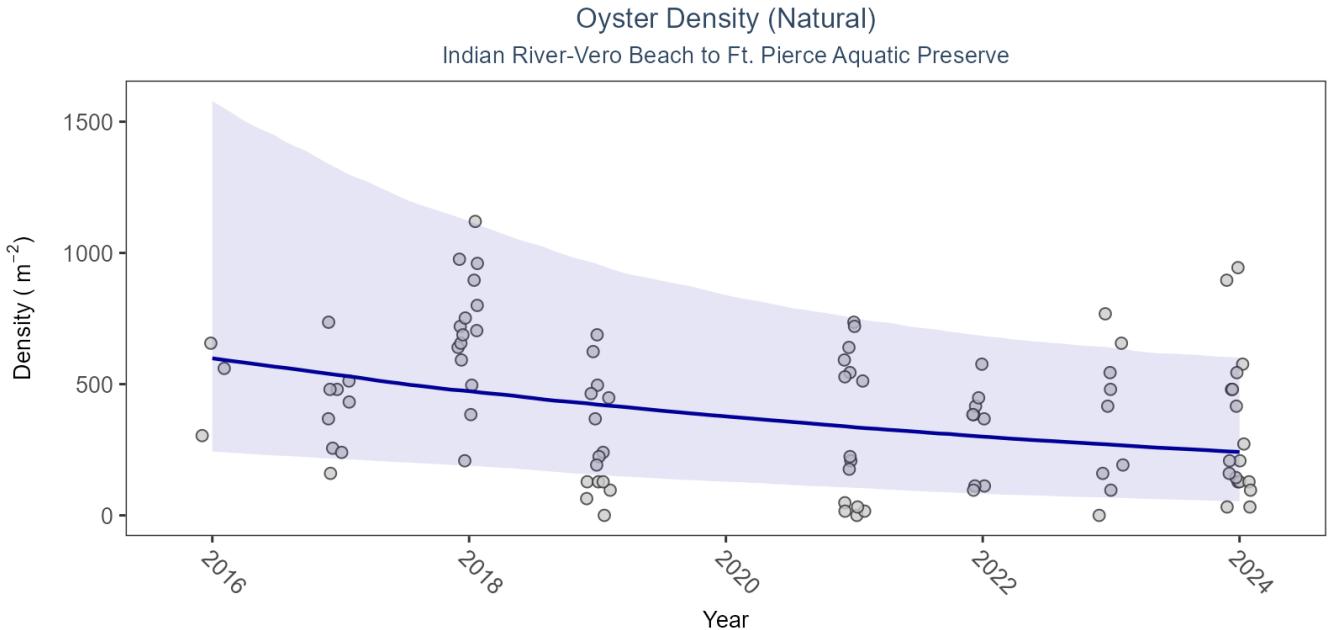


Figure 32: Scatter plot of oyster density over time. If the time series included five or more years with observations, an estimated trend (blue line) and a 95% credible interval (purple band) may also be plotted. Data points are jittered horizontally to reduce overlap.

Table 34: Model results for Oyster Density - Natural

Shell Type	Habitat Type	Trend Status	Estimate	Standard Error	Credible Interval
Live Oysters	Natural	Significantly decreasing trend	-44.1	218.52	-23.88 to -118.93

For natural reefs, density decreased by an average of 44.37 oysters per square meter per year.

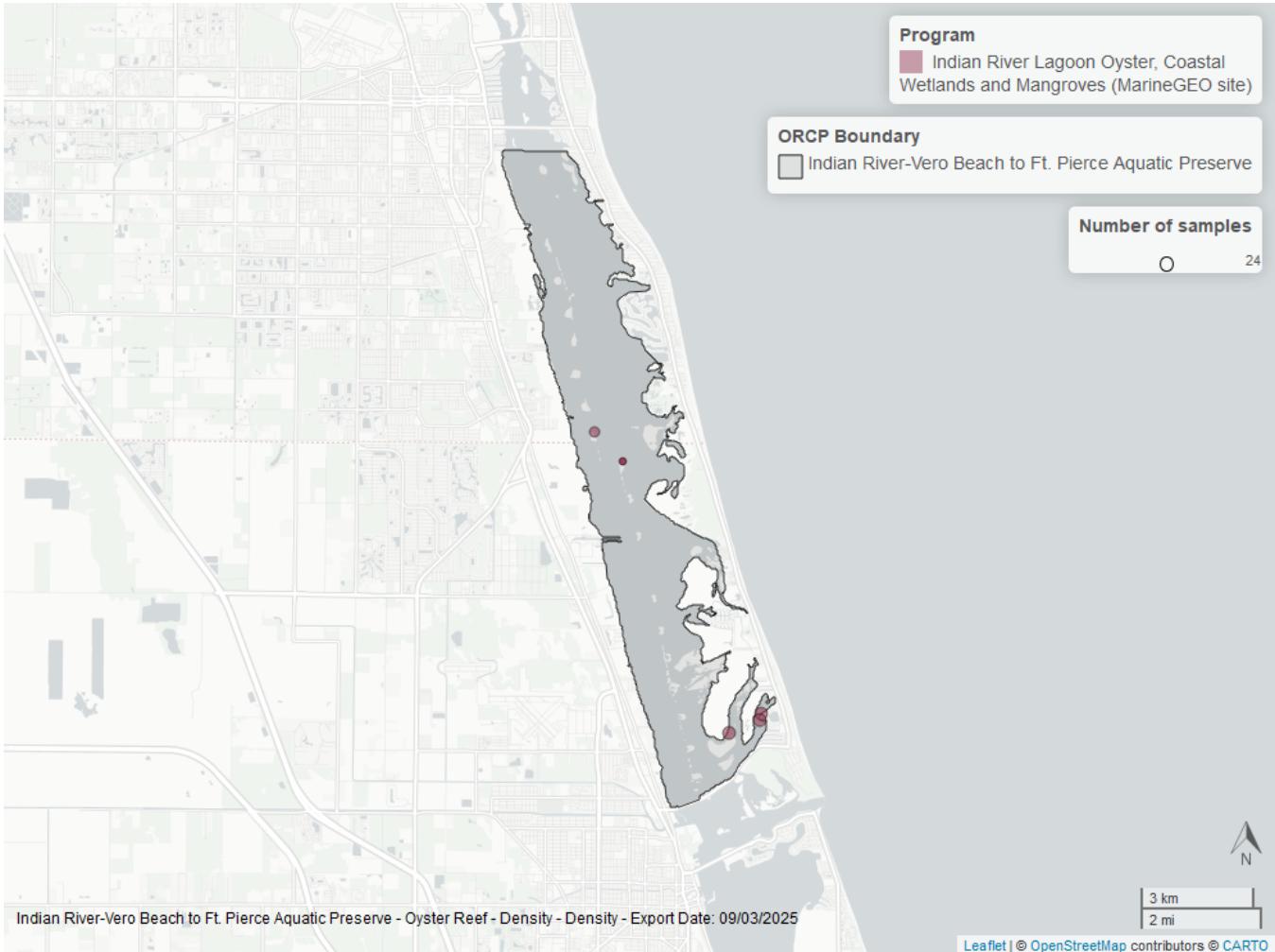


Figure 33: Map showing location of oyster density sampling locations within the boundaries of *Indian River-Vero Beach to Ft. Pierce Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Percent Live

Natural

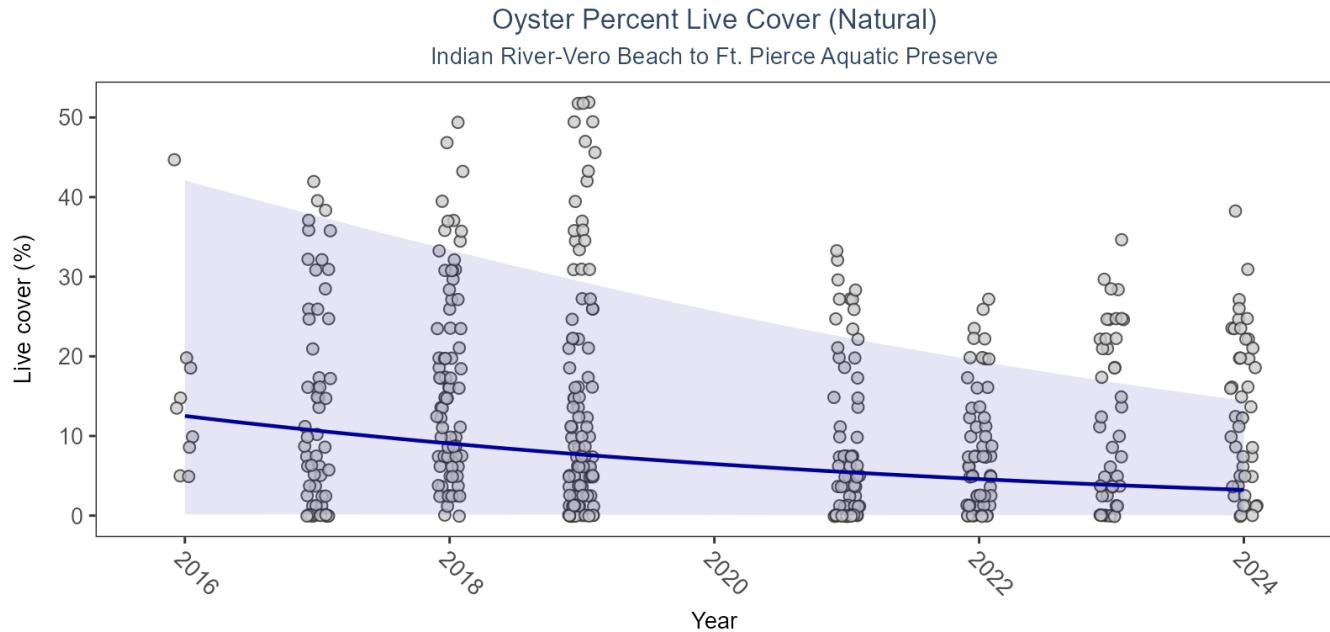


Figure 34: Scatter plot of percent live oysters over time. If the time series included five or more years with observations, an estimated trend (blue line) and a 95% credible interval (purple band) may also be plotted. Data points are jittered horizontally to reduce overlap.

Table 35: Model results for Oyster Percent Live - Natural

<i>Shell Type</i>	<i>Habitat Type</i>	<i>Trend Status</i>	<i>Estimate</i>	<i>Standard Error</i>	<i>Credible Interval</i>
Live Oysters	Natural	Significantly decreasing trend	-1.16	9.92	-0.01 to -3.46

For natural reefs, percent live cover decreased by an average of 1.17% per year.

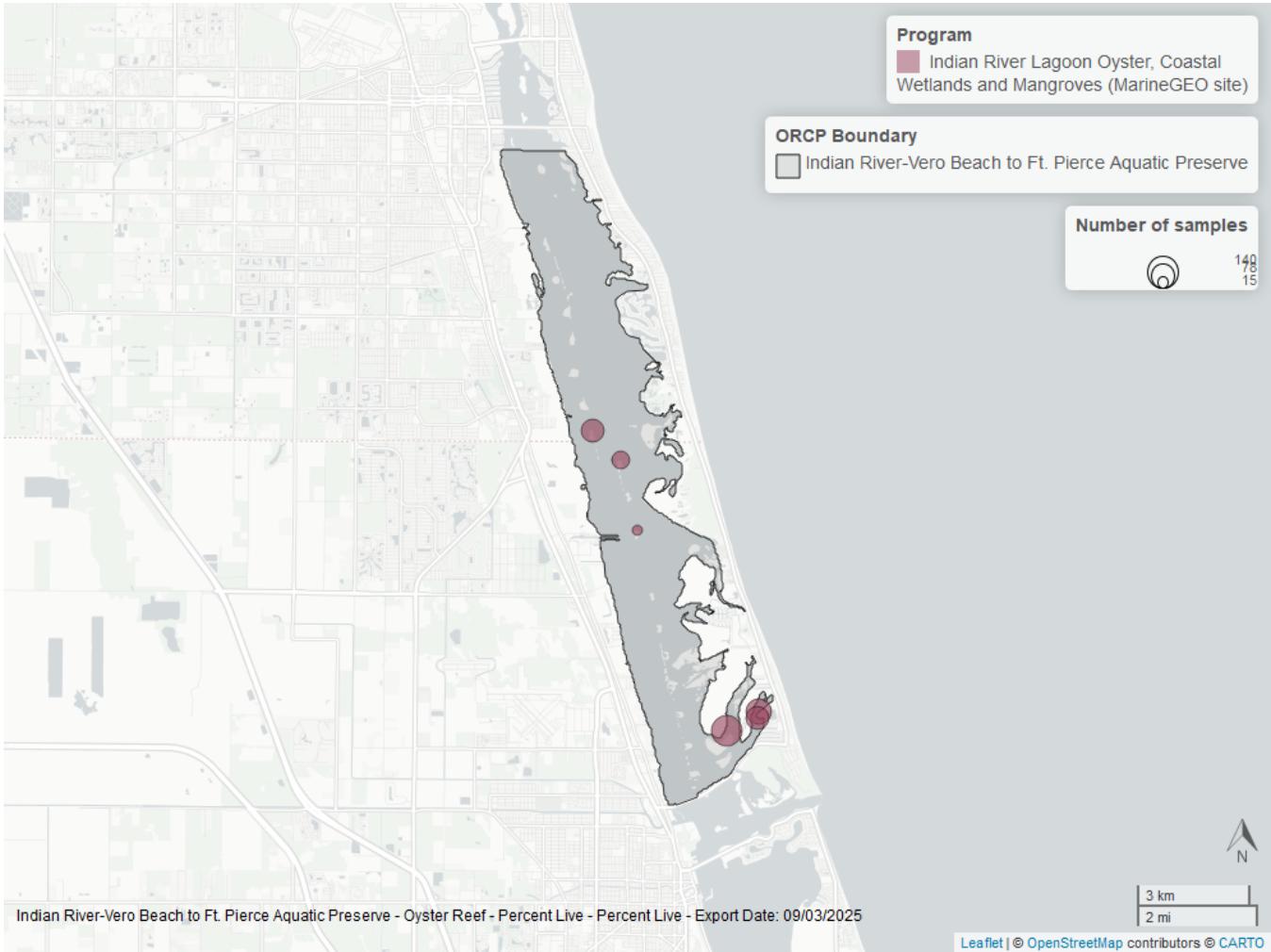


Figure 35: Map showing location of oyster percent live sampling locations within the boundaries of *Indian River-Vero Beach to Ft. Pierce Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Shell Height

Natural

Oyster Size Class (Natural)
Indian River-Vero Beach to Ft. Pierce Aquatic Preserve

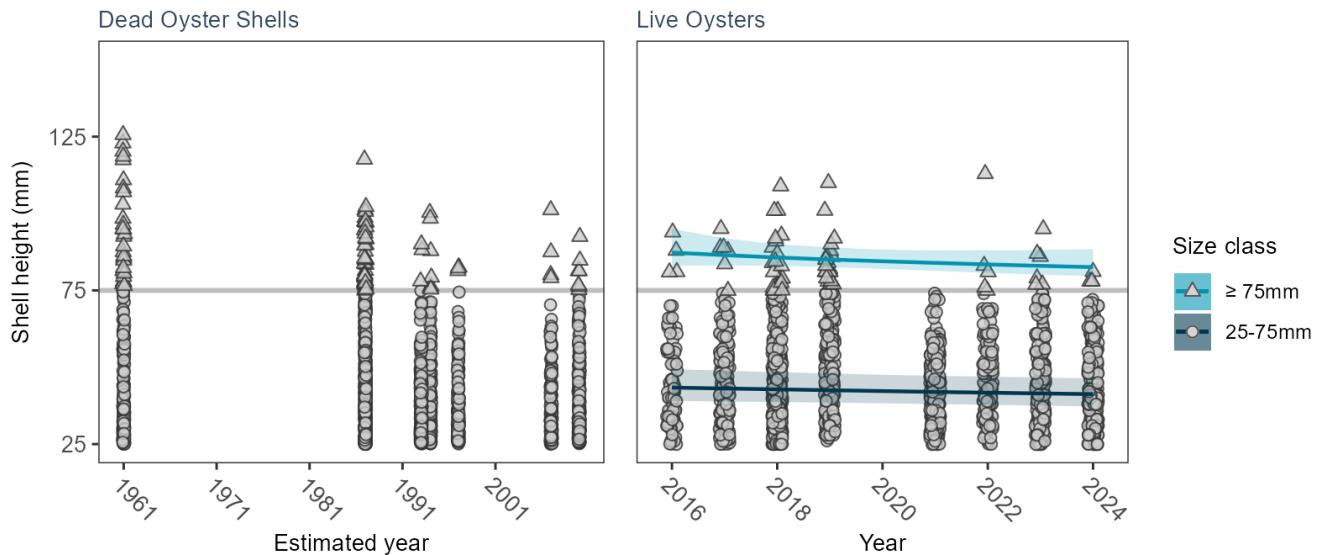


Table 36: Model results for Oyster Shell Height - Natural

Shell Type	SizeClass	Habitat Type	Trend Status	Estimate	Standard Error	Credible Interval
Dead Oyster Shells		Natural	-	-	-	-
Dead Oyster Shells	>75mm	Natural	-	-	-	-
Dead Oyster Shells	25-75mm	Natural	-	-	-	-
Live Oysters		Natural	-	-	-	-
Live Oysters	>75mm	Natural	No significant change	-2.71	2.59	-8.62 to 1.51
Live Oysters	25-75mm	Natural	Significantly decreasing trend	-0.75	0.34	-1.44 to -0.07

For natural reefs, annual average live oyster shell height in the 25-75mm and $\geq 75\text{mm}$ size classes decreased by 0.75 mm per year and 2.71 mm per year, respectively. Models are not run on dead oyster shell measurements.

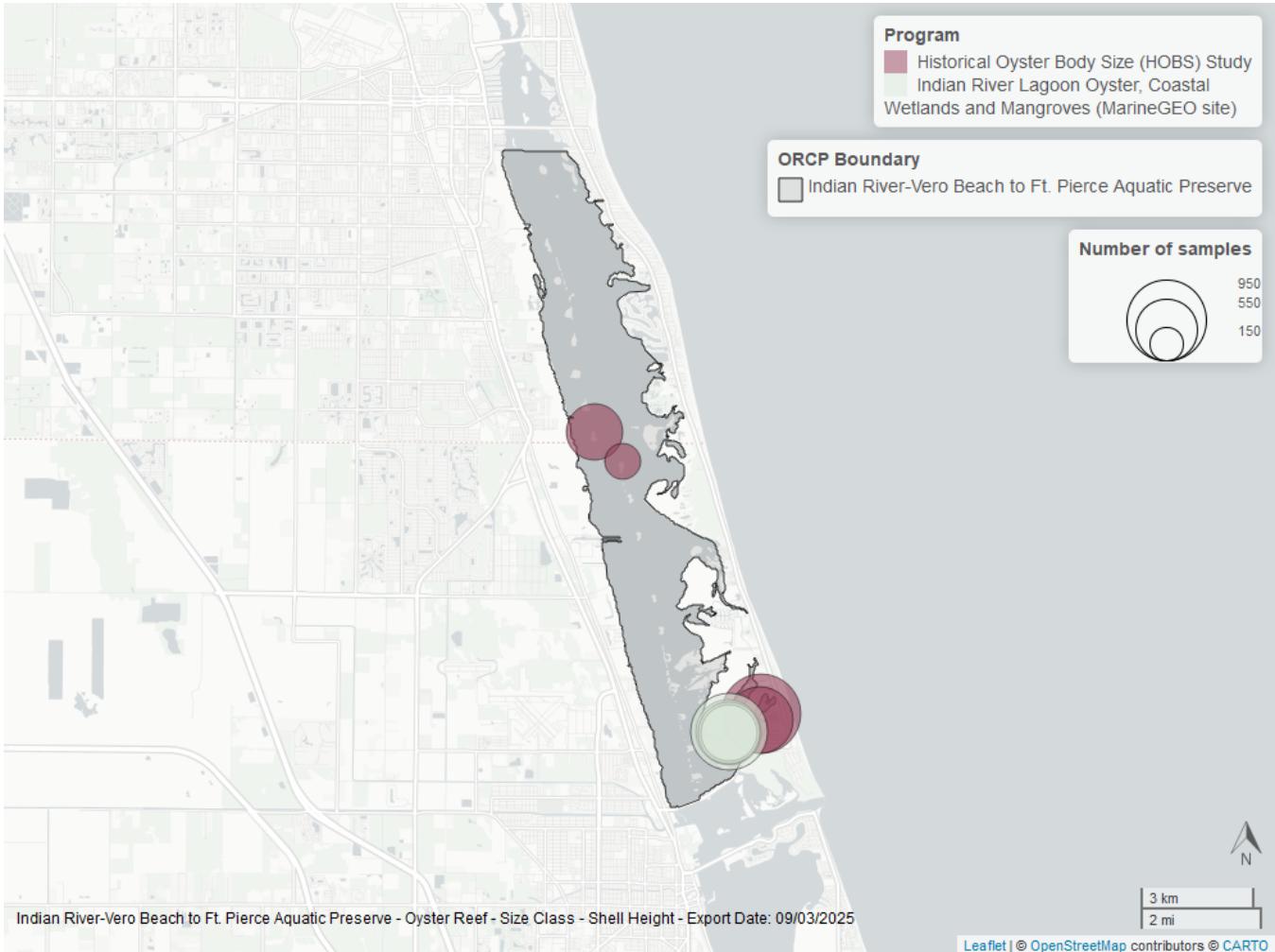


Figure 36: Map showing location of oyster shell height sampling locations within the boundaries of *Indian River-Vero Beach to Ft. Pierce Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Species list

Caulerpa ¹	Halophila engelmannii ¹	Thalassia testudinum ¹
Drift algae ¹	Halophila johnsonii ¹	Total SAV ¹
Halodule wrightii ¹	Ruppia maritima ¹	Total seagrass ¹
Halophila decipiens ¹	Syringodium filiforme ¹	Caulerpa ¹

1 - Submerged Aquatic Vegetation

References

1. Florida Department of Agriculture and Consumer Services (FDACS) - Division of Aquaculture. [Shellfish Harvest Area Classification Program](#). (2022).
2. Florida Department of Environmental Protection (DEP). [Florida STORET / WIN](#). (2024).
3. U.S. Environmental Protection Agency (EPA). [EPA STOrage and RETrieval Data Warehouse \(STORET\)/WQX](#). (2023).
4. U.S. Environmental Protection Agency (EPA); Office of Water; National Oceanic and Atmospheric Administration (NOAA); U.S. Geological Survey (USGS); U.S. Fish and Wildlife Service (USFWS); National Estuary Program (NEP); coastal states. [National Aquatic Resource Surveys, National Coastal Condition Assessment](#). (2021).
5. Florida Fish and Wildlife Conservation Commission (FWC). [Fisheries-Independent Monitoring \(FIM\) Program](#). (2022).
6. Florida Fish and Wildlife Conservation Commission (FWC); Florida Fish and Wildlife Research Institute (FWRI). [Harmful Algal Bloom Marine Observation Network](#). (2018).
7. U.S. Environmental Protection Agency (EPA); Office of Research and Development. [Environmental Monitoring Assessment Program](#). (2004).
8. Volusia County (Florida); Marine Discovery Center. [Lagoon Watch \(Formerly Marine Discovery Center\)](#). (2023).
9. St. Johns River Water Management District (SJRWMD). [Seagrass \(SJRWMD\)](#). (2023).