

Yellow River Marsh Aquatic Preserve

SEACAR Habitat Analyses

Last compiled on 22 May, 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-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

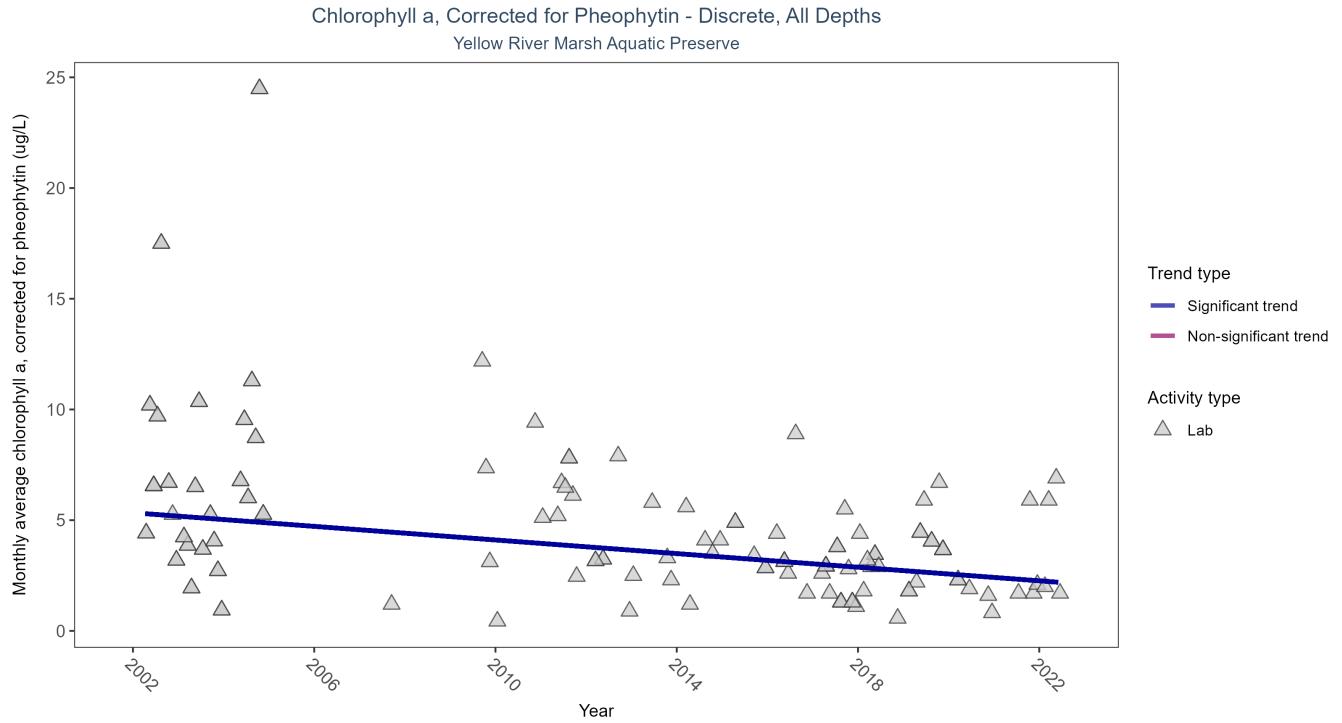


Figure 1: Scatter plot of monthly average levels of chlorophyll a, corrected for pheophytin, over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed chlorophyll a (triangles) 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	142	18	2002 - 2022	3.75	-0.3054	5.3353	-0.1537	0.0001

Monthly average chlorophyll a, corrected for pheophytin, decreased by 0.15 µg/L per year, indicating an increase in water clarity.

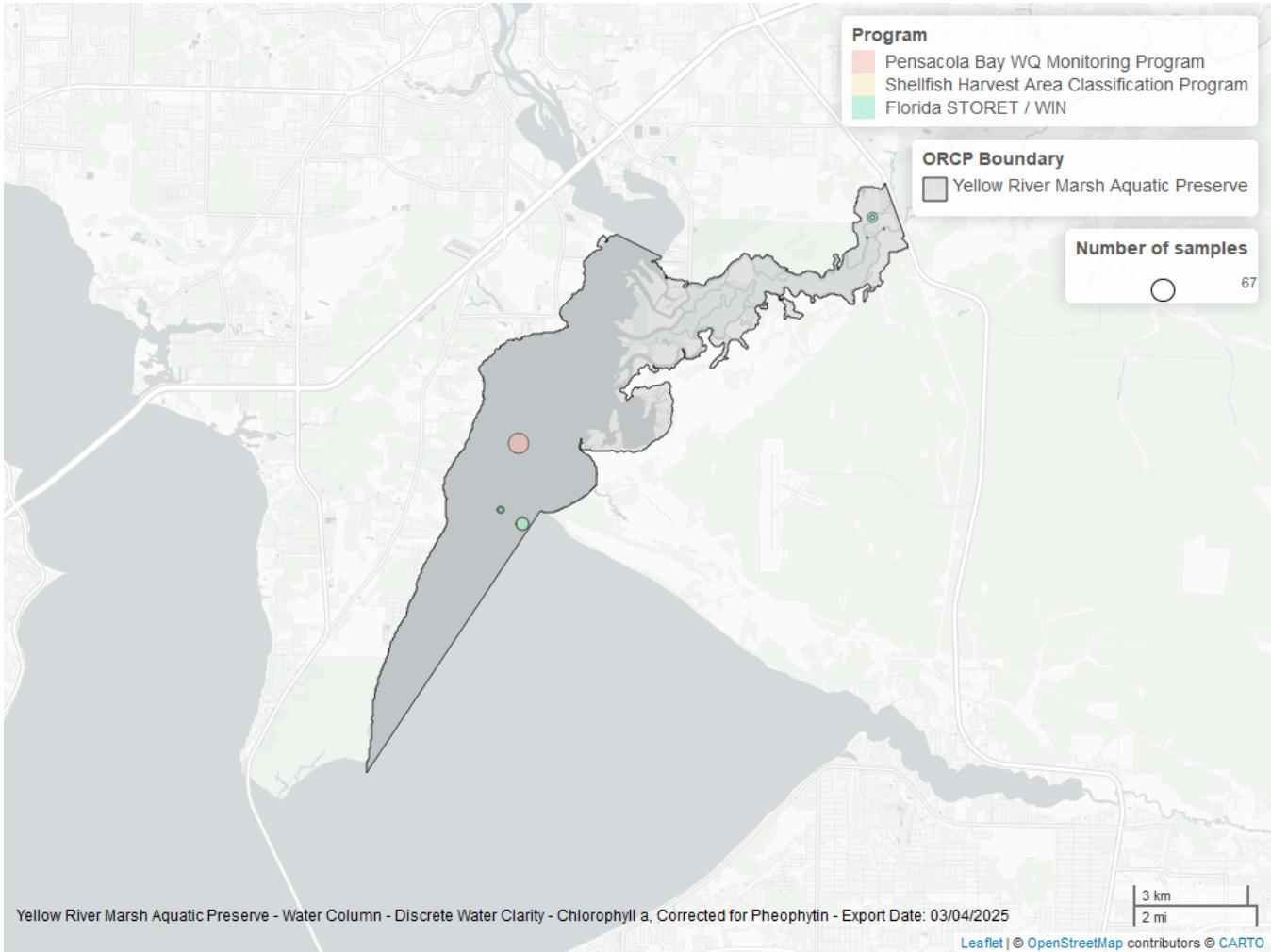


Figure 2: Map showing location of discrete water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

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

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
505	67	2002	2012
5002	56	2007	2020
540	22	2016	2022

Program names:

505 - Pensacola Bay Water Quality Monitoring Program¹

540 - Shellfish Harvest Area Classification Program²

5002 - Florida STORET / WIN³

Chlorophyll a, Uncorrected for Pheophytin - Discrete

Seasonal Kendall-Tau Trend Analysis

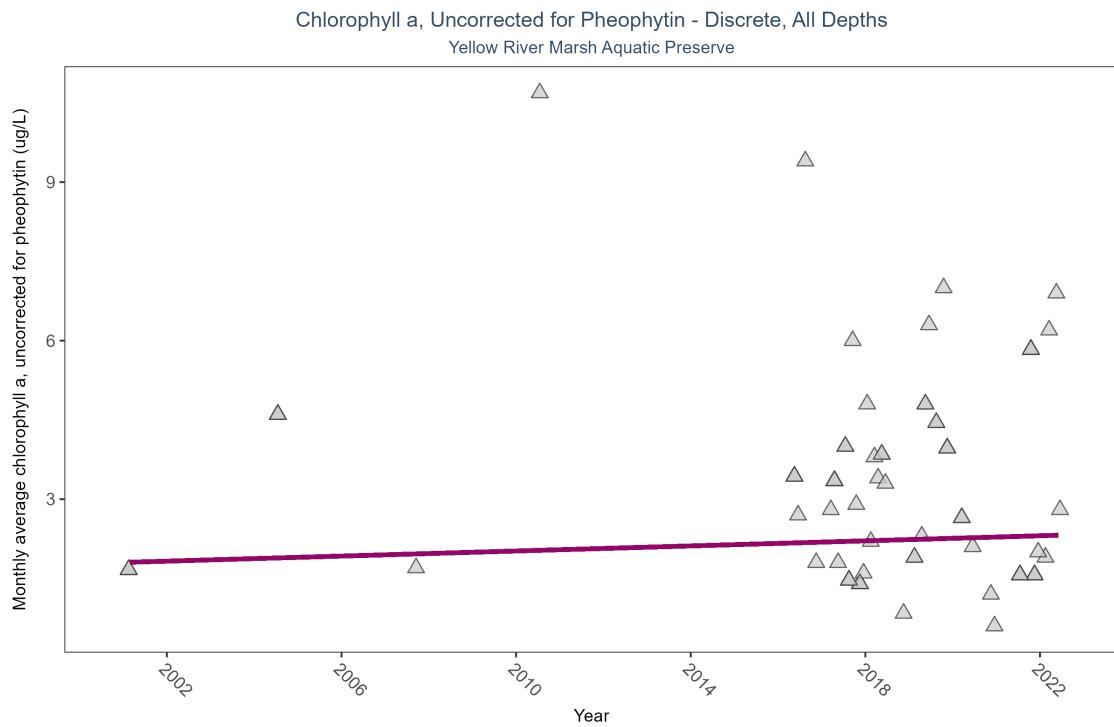


Figure 3: Scatter plot of monthly average levels of chlorophyll a, uncorrected for pheophytin, over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed chlorophyll a (triangles) 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	70	11	2001 - 2022	2.75	0.1175	1.8028	0.024	0.5531

Chlorophyll a, uncorrected for pheophytin, showed no detectable trend between 2001 and 2022.

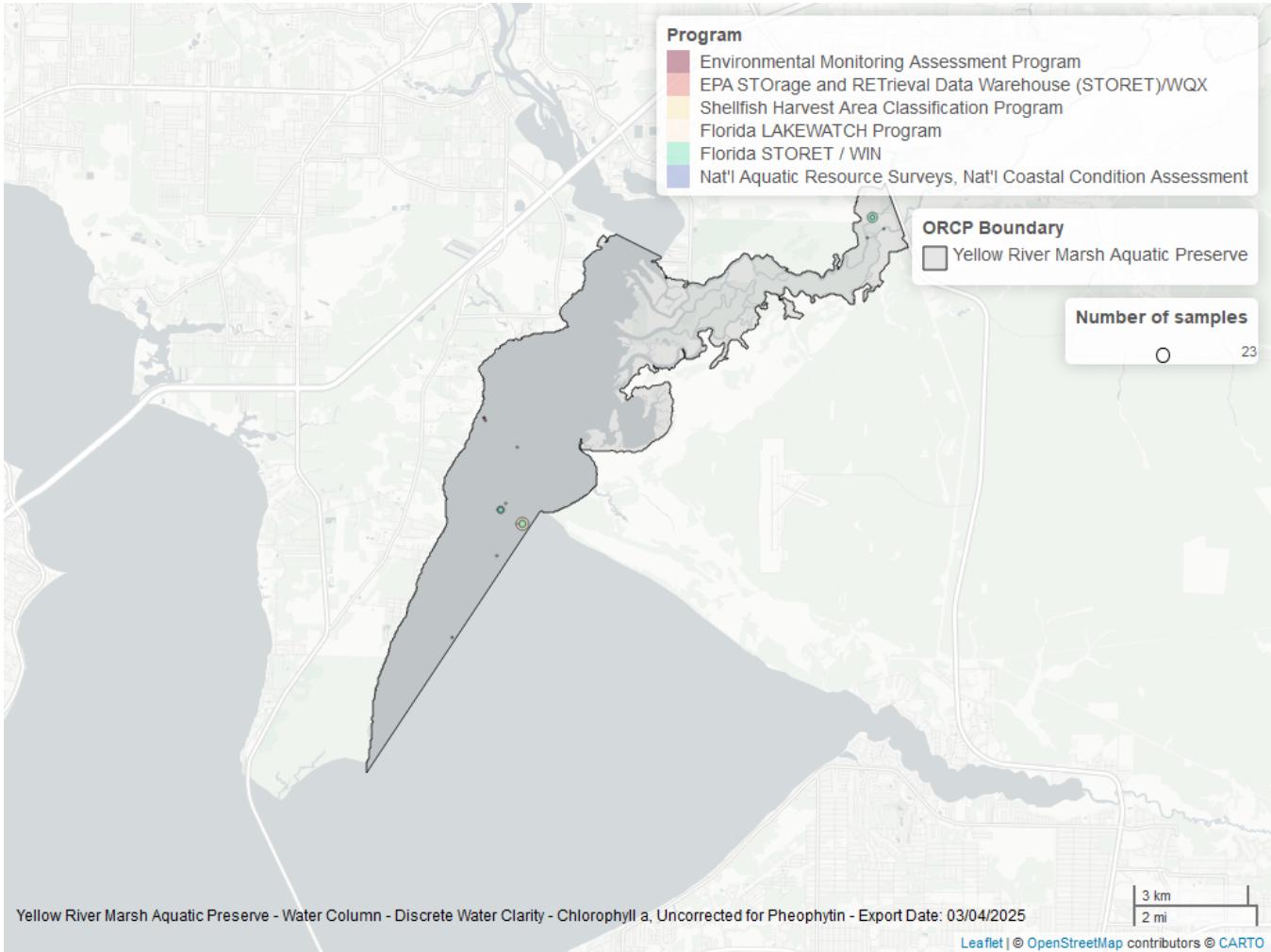


Figure 4: Map showing location of discrete water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

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

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
5002	42	2007	2020
540	23	2016	2022
103	8	2004	2021
514	3	2001	2001
115	1	2004	2004
118	1	2010	2010

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX⁴

115 - Environmental Monitoring Assessment Program⁵

118 - National Aquatic Resource Surveys, National Coastal Condition Assessment⁶

514 - Florida LAKEWATCH Program⁷

540 - Shellfish Harvest Area Classification Program²

5002 - Florida STORET / WIN³

Dissolved Oxygen - Discrete

Seasonal Kendall-Tau Trend Analysis

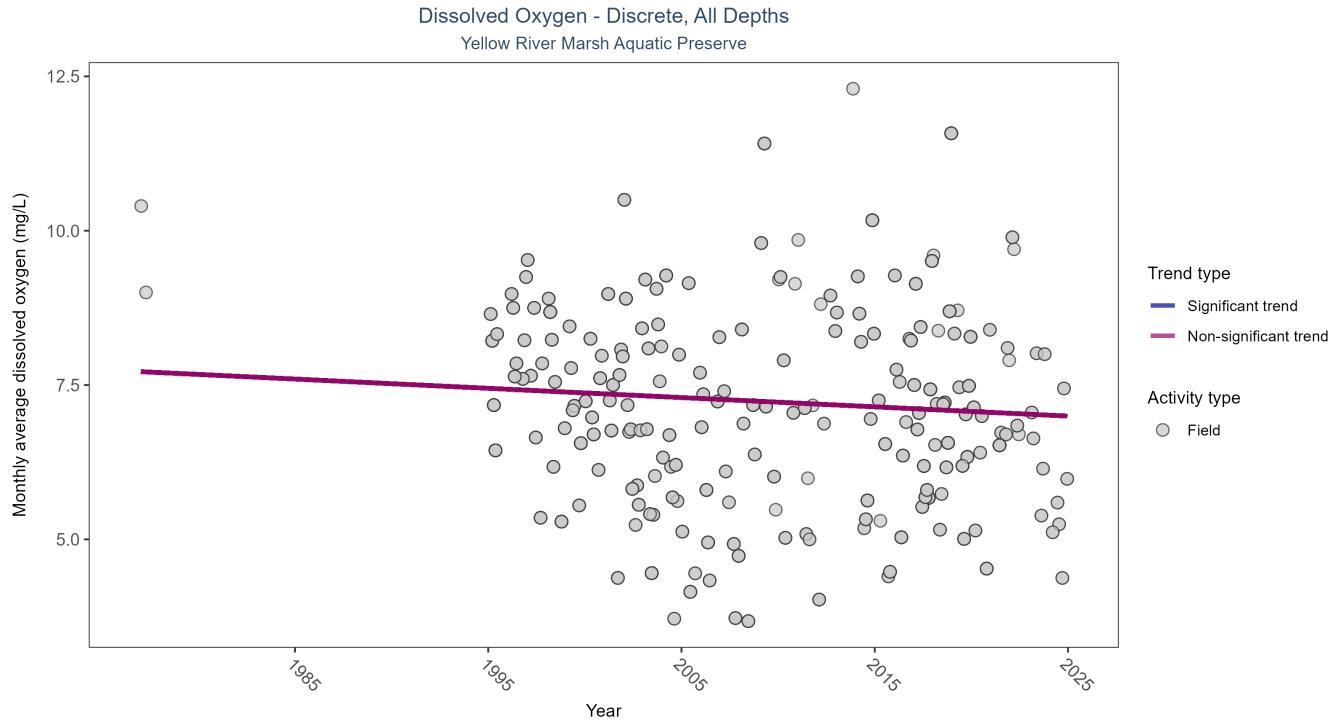


Figure 5: Scatter plot of monthly average dissolved oxygen over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only dissolved oxygen values measured in the field (circles) are included in the plot.

Table 10: Seasonal Kendall-Tau Trend Analysis for Dissolved Oxygen

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Field	No significant trend	1109	31	1977 - 2024	7.2	-0.0483	7.7168	-0.015	0.1659

Dissolved oxygen showed no detectable trend between 1977 and 2024.

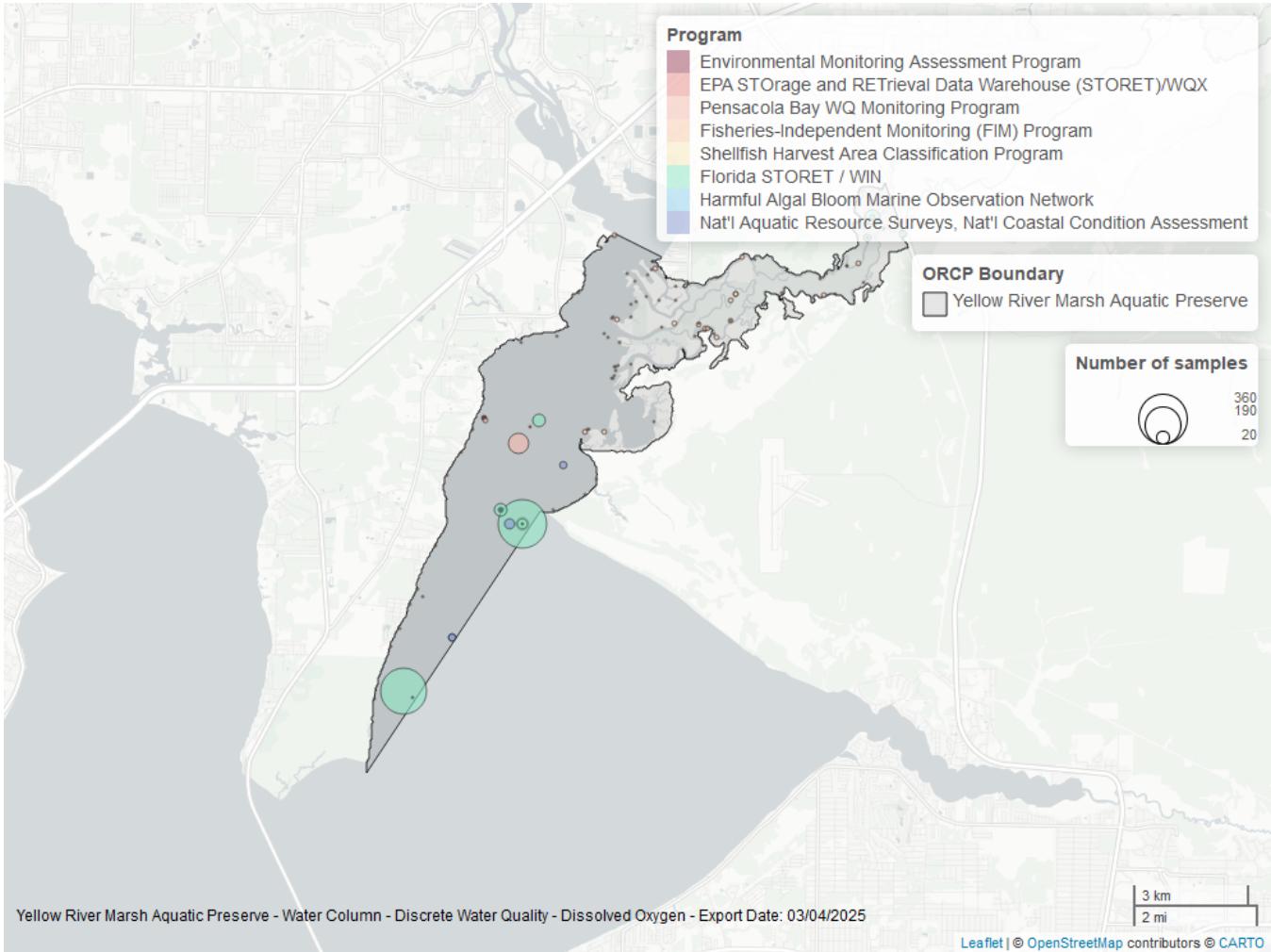


Figure 6: Map showing location of discrete water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 11: Programs contributing data for Dissolved Oxygen

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
5002	809	1995	2024
69	168	2003	2019
505	66	2002	2012
118	41	2015	2021
540	21	2016	2022
103	7	1977	2021
95	4	2000	2017
115	3	2004	2004

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program⁸

95 - Harmful Algal Bloom Marine Observation Network⁹

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX⁴

115 - Environmental Monitoring Assessment Program⁵

118 - National Aquatic Resource Surveys, National Coastal Condition Assessment⁶

505 - Pensacola Bay Water Quality Monitoring Program¹

540 - Shellfish Harvest Area Classification Program²

5002 - Florida STORET / WIN³

Dissolved Oxygen Saturation - Discrete

Seasonal Kendall-Tau Trend Analysis

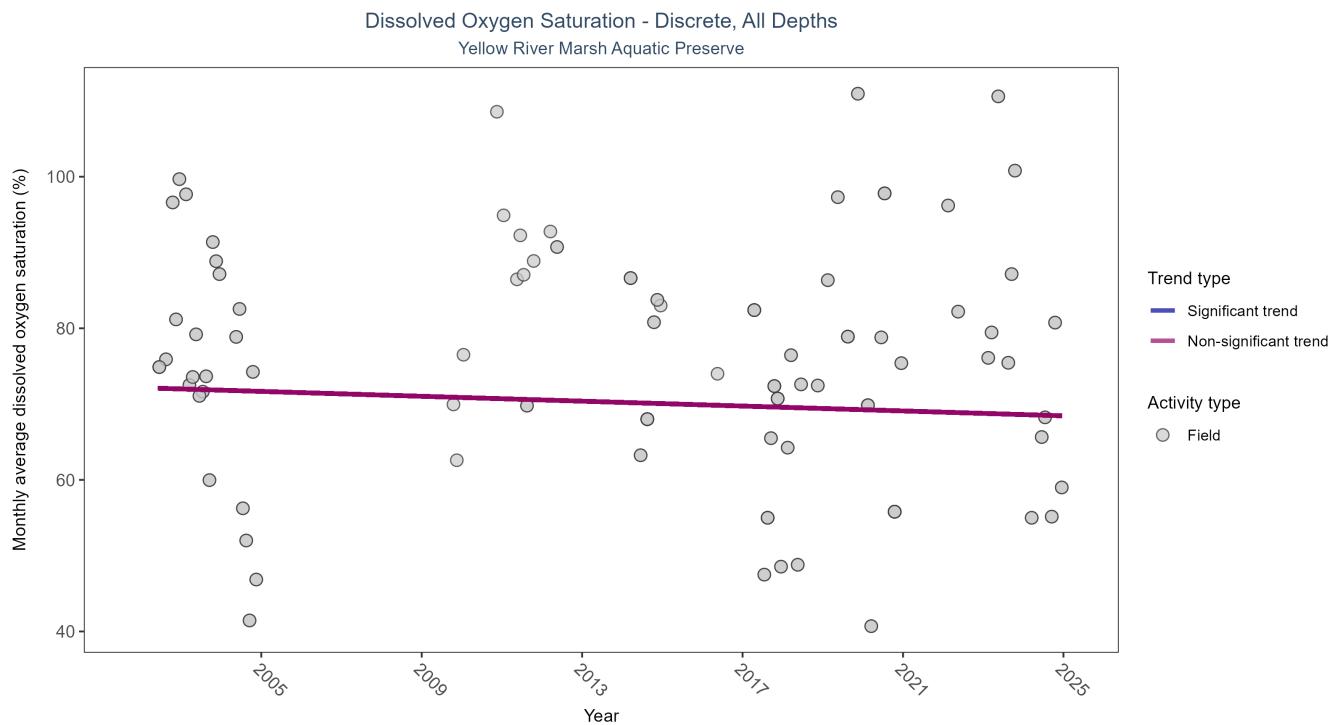


Figure 7: Scatter plot of monthly average dissolved oxygen saturation over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only dissolved oxygen saturation values measured in the field (circles)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

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

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Field	No significant trend	175	16	2002 - 2024	76.2	-0.0105	72.1564	-0.1611	0.68

Dissolved oxygen saturation showed no detectable trend between 2002 and 2024.

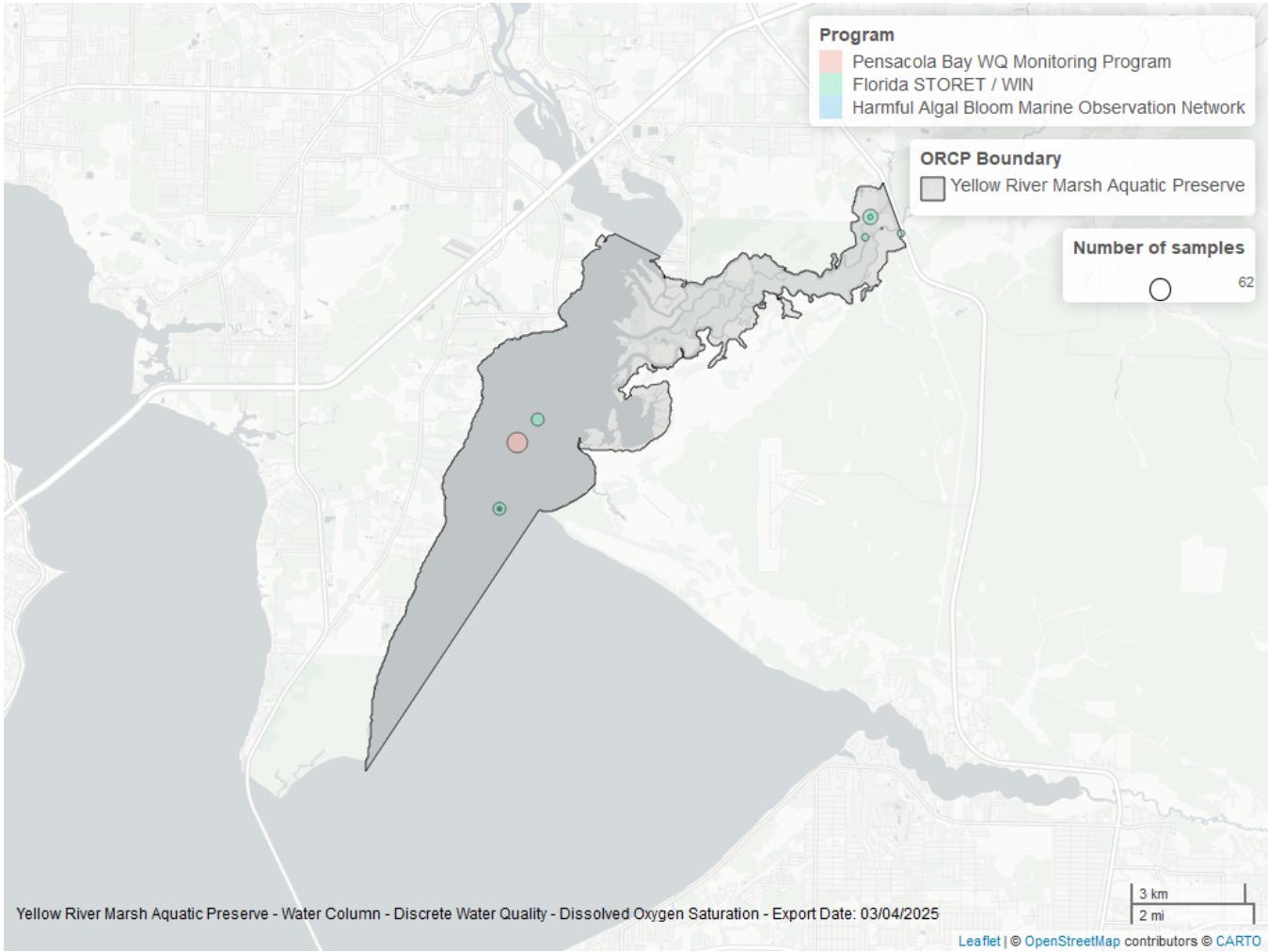


Figure 8: Map showing location of discrete water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 13: Programs contributing data for Dissolved Oxygen Saturation

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
5002	116	2014	2024
505	62	2002	2012
95	1	2017	2017

Program names:

95 - Harmful Algal Bloom Marine Observation Network⁹

505 - Pensacola Bay Water Quality Monitoring Program¹

5002 - Florida STORET / WIN³

pH - Discrete

Seasonal Kendall-Tau Trend Analysis

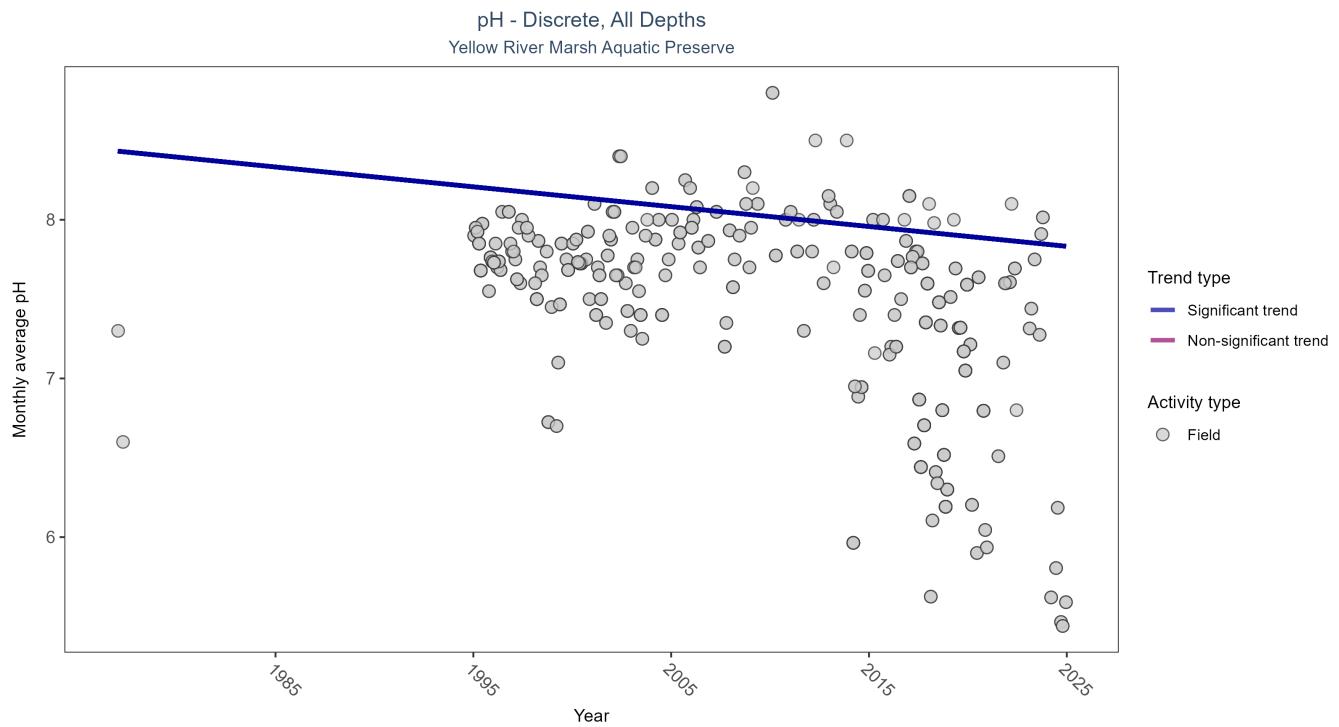


Figure 9: Scatter plot of monthly average pH over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only pH values measured in the field (circles) are included in the plot.

Table 14: Seasonal Kendall-Tau Trend Analysis for pH

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Field	Significantly decreasing trend	742	31	1977 - 2024	7.6	-0.1594	8.4327	-0.0125	0.002

Monthly average pH decreased by 0.01 pH units per year.

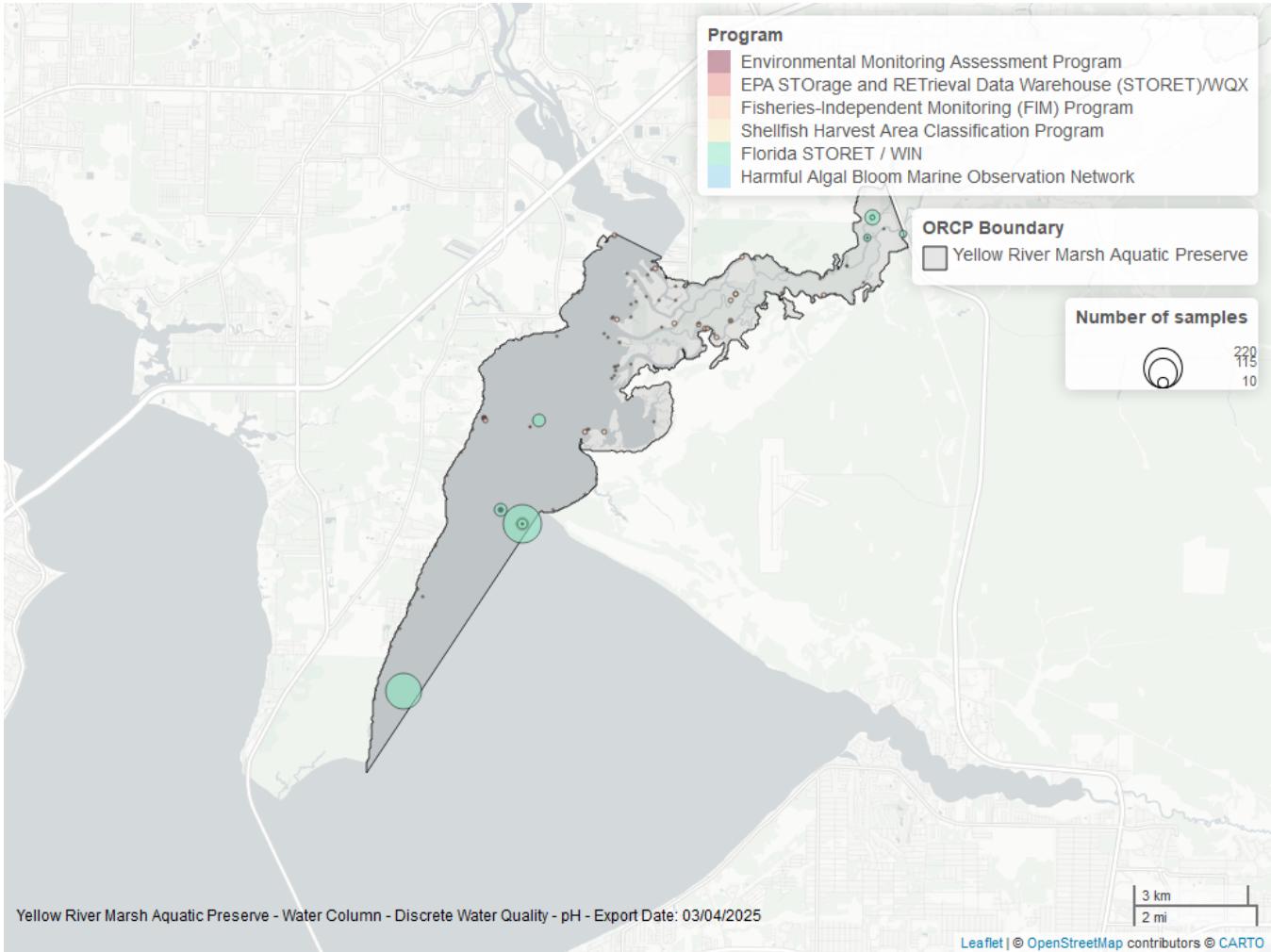


Figure 10: Map showing location of discrete water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 15: Programs contributing data for pH

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
5002	558	1995	2024
69	160	2003	2019
540	21	2016	2022
103	7	1977	2021
95	3	2014	2017
115	3	2004	2004

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program⁸

95 - Harmful Algal Bloom Marine Observation Network⁹

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX⁴

115 - Environmental Monitoring Assessment Program⁵

540 - Shellfish Harvest Area Classification Program²

5002 - Florida STORET / WIN³

Salinity - Discrete

Seasonal Kendall-Tau Trend Analysis

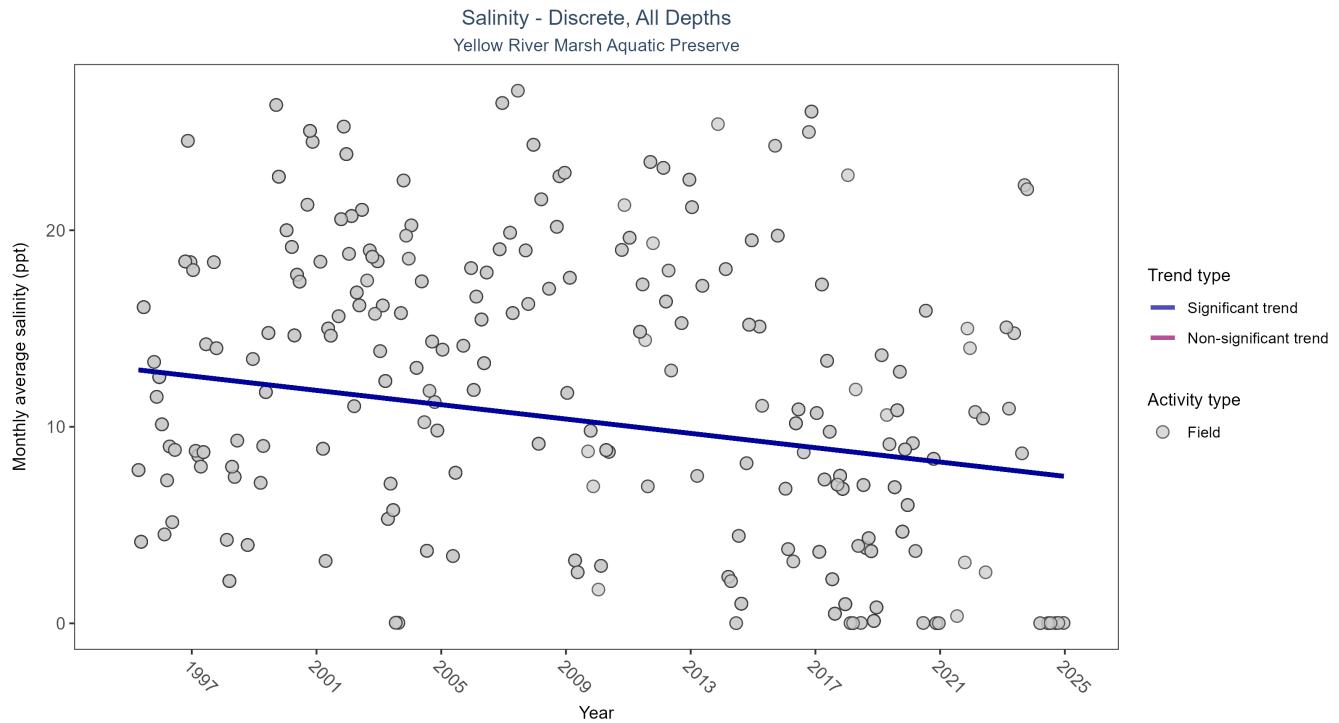


Figure 11: Scatter plot of monthly average salinity over time. If the time series included ten or more years of discrete observations, significant (blue) or non-significant (magenta) trend lines are also shown. Discrete salinity values derived from grab samples analyzed in the field (circles) or the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

Table 16: Seasonal Kendall-Tau Trend Analysis for Salinity

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
All	Significantly decreasing trend	1246	30	1995 - 2024	11	-0.1197	12.947	-0.1823	0.0102

Monthly average salinity decreased by 0.18 ppt per year.

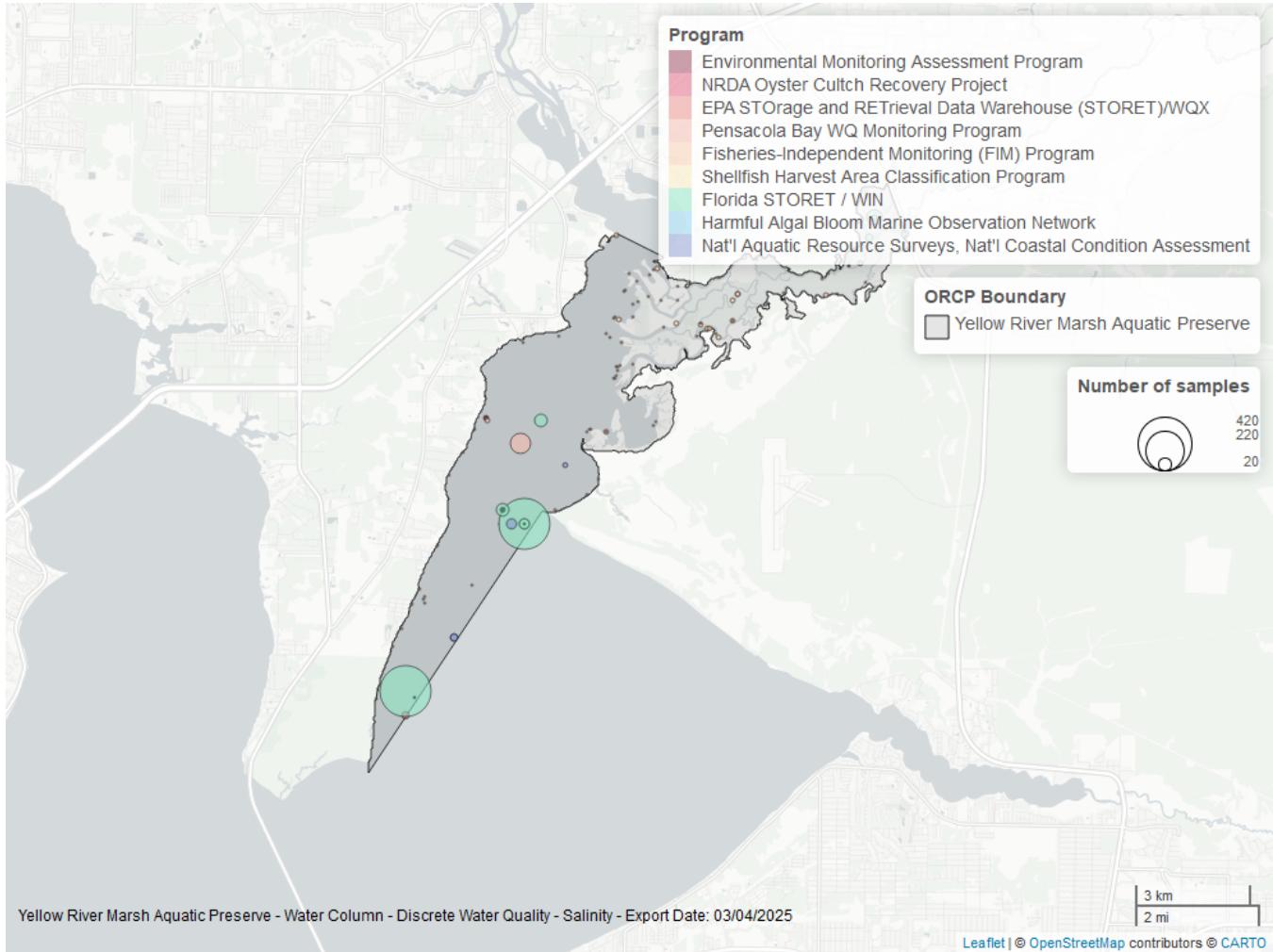


Figure 12: Map showing location of discrete water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 17: Programs contributing data for Salinity

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
5002	928	1995	2024
69	180	2003	2019
505	67	2002	2012
118	40	2015	2021
540	19	2016	2022
4044	10	2017	2023
95	4	2000	2017
115	3	2004	2004
103	2	2004	2004

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program⁸

95 - Harmful Algal Bloom Marine Observation Network⁹

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX⁴

115 - Environmental Monitoring Assessment Program⁵

118 - National Aquatic Resource Surveys, National Coastal Condition Assessment⁶

505 - Pensacola Bay Water Quality Monitoring Program¹

540 - Shellfish Harvest Area Classification Program²

4044 - NRDA Oyster Cultch Recovery Project¹⁰

5002 - Florida STORET / WIN³

Secchi Depth - Discrete

Seasonal Kendall-Tau Trend Analysis

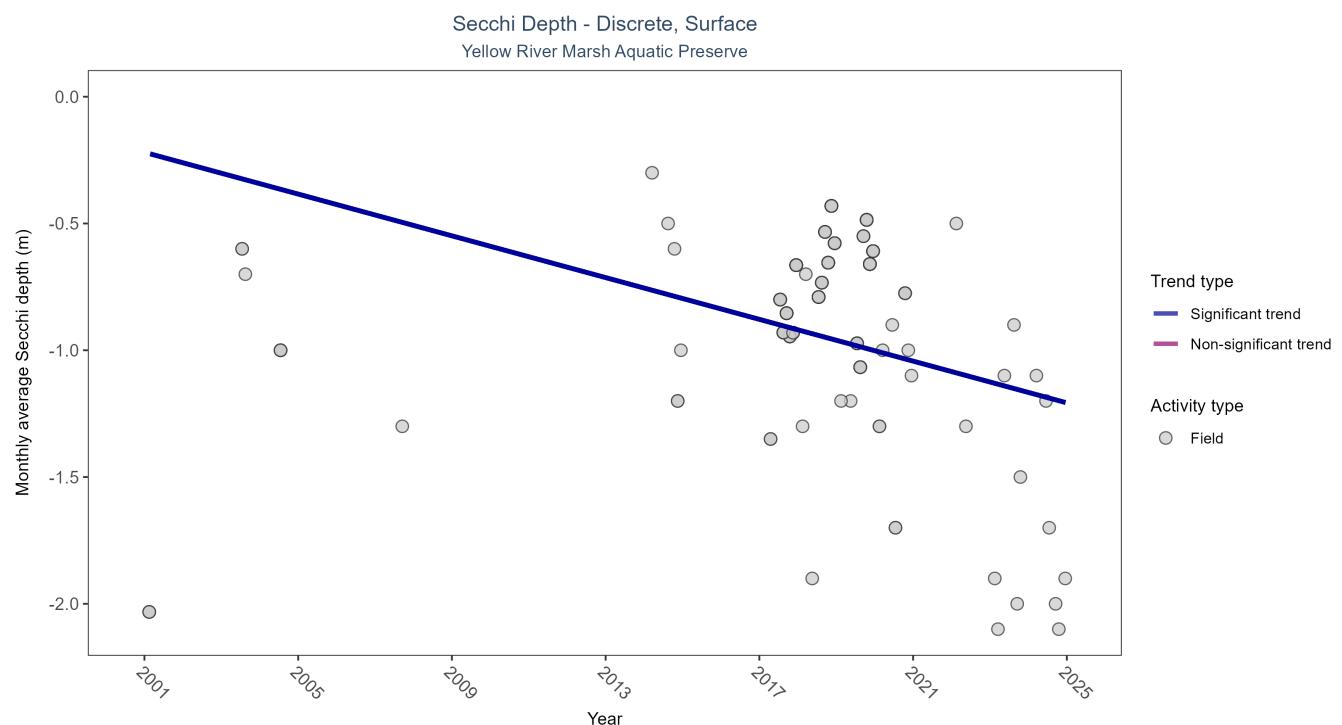


Figure 13: Scatter plot of monthly average Secchi depth over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Secchi depth is only measured in the field (circles).

Table 18: Seasonal Kendall-Tau Trend Analysis for Secchi Depth

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Field	Significantly decreasing trend	237	12	2001 - 2024	-0.8	-0.2741	-0.2193	-0.0412	0.0174

Monthly average Secchi depth became deeper by 0.04 m per year, indicating an increase in water clarity.

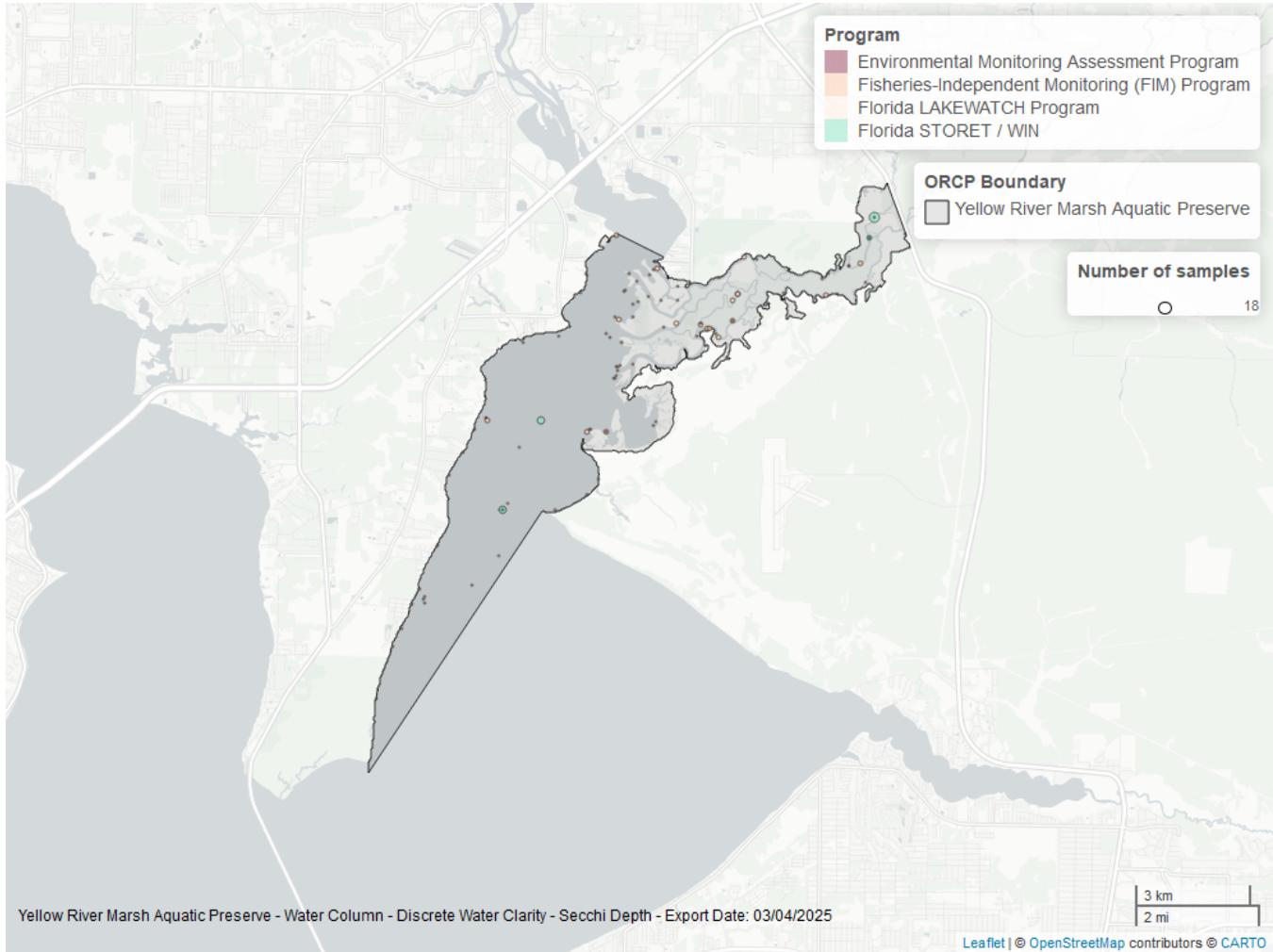


Figure 14: Map showing location of discrete water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 19: Programs contributing data for Secchi Depth

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
69	180	2003	2019
5002	53	2007	2024
514	3	2001	2001
115	1	2004	2004

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program⁸

115 - Environmental Monitoring Assessment Program⁵

514 - Florida LAKEWATCH Program⁷

5002 - Florida STORET / WIN³

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

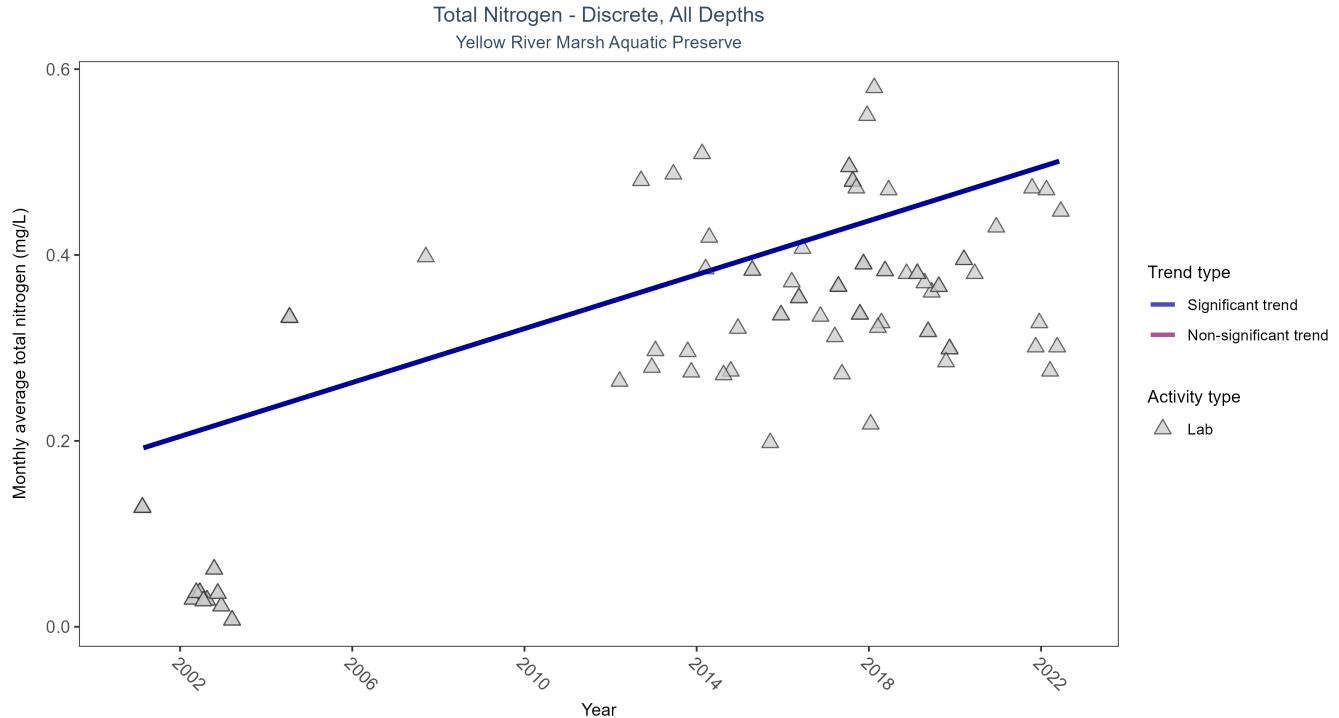


Figure 15: Scatter plot of monthly average total nitrogen over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only nitrogen values obtained from laboratory analyses (triangles) are included in the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

Table 20: Seasonal Kendall-Tau Trend Analysis for Total Nitrogen

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Lab	Significantly increasing trend	109	16	2001 - 2022	0.322	0.2823	0.1903	0.0145	0.0088

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

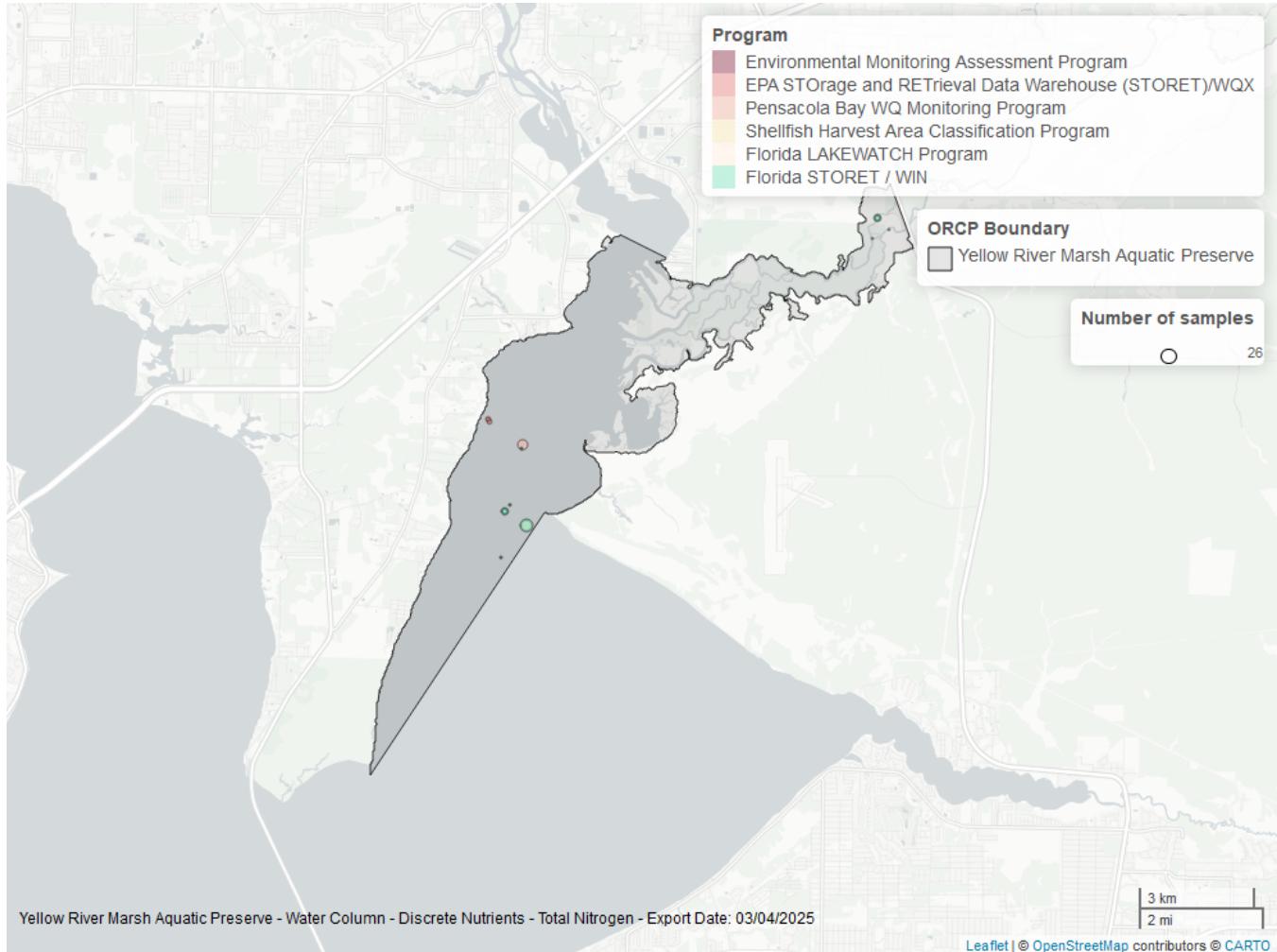


Figure 16: Map showing location of discrete water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 21: Programs contributing data for Total Nitrogen

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
5002	59	2001	2020
505	20	2002	2003
540	19	2017	2022
103	7	2004	2004
514	3	2001	2001
115	1	2004	2004

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX⁴

115 - Environmental Monitoring Assessment Program⁵

505 - Pensacola Bay Water Quality Monitoring Program¹

514 - Florida LAKEWATCH Program⁷

540 - Shellfish Harvest Area Classification Program²

5002 - Florida STORET / WIN³

Total Phosphorus - Discrete

Seasonal Kendall-Tau Trend Analysis

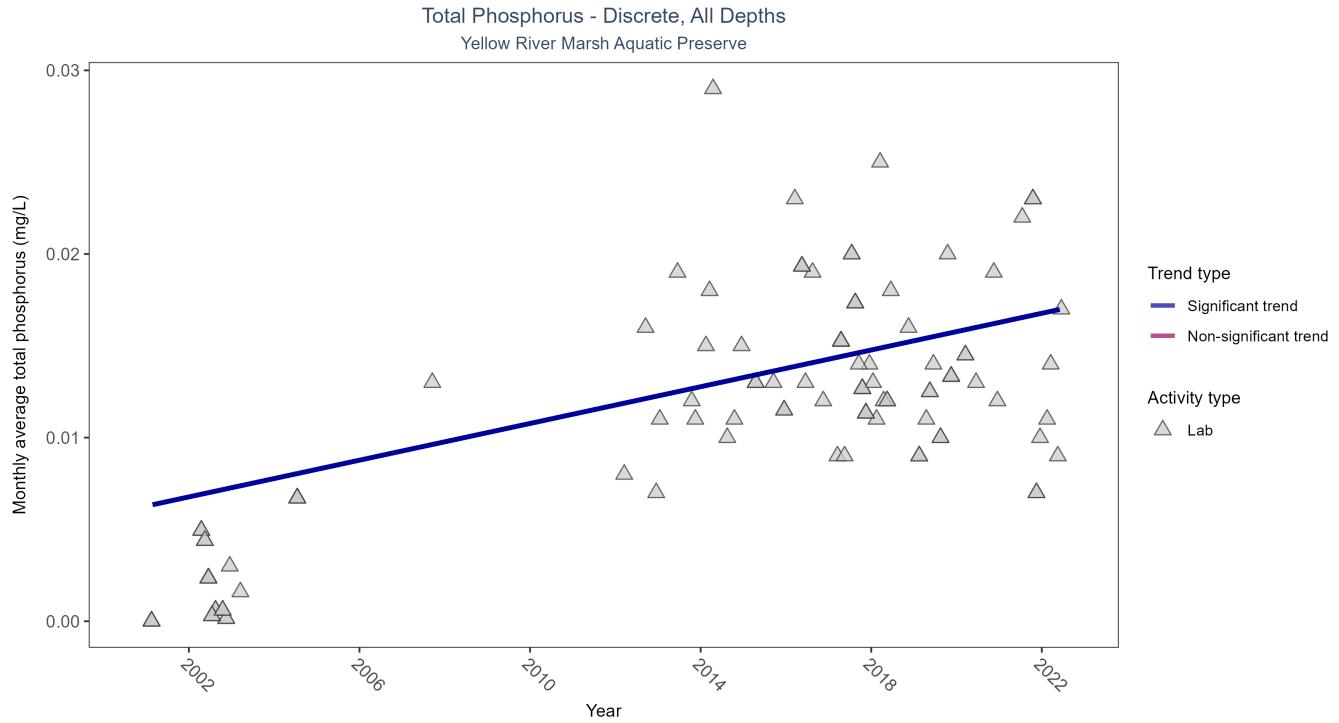


Figure 17: Scatter plot of monthly average total phosphorus over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only phosphorus values obtained from laboratory analyses (triangles) are included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

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

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Lab	Significantly increasing trend	105	16	2001 - 2022	0.0117	0.3174	0.0063	0.0005	0.0066

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

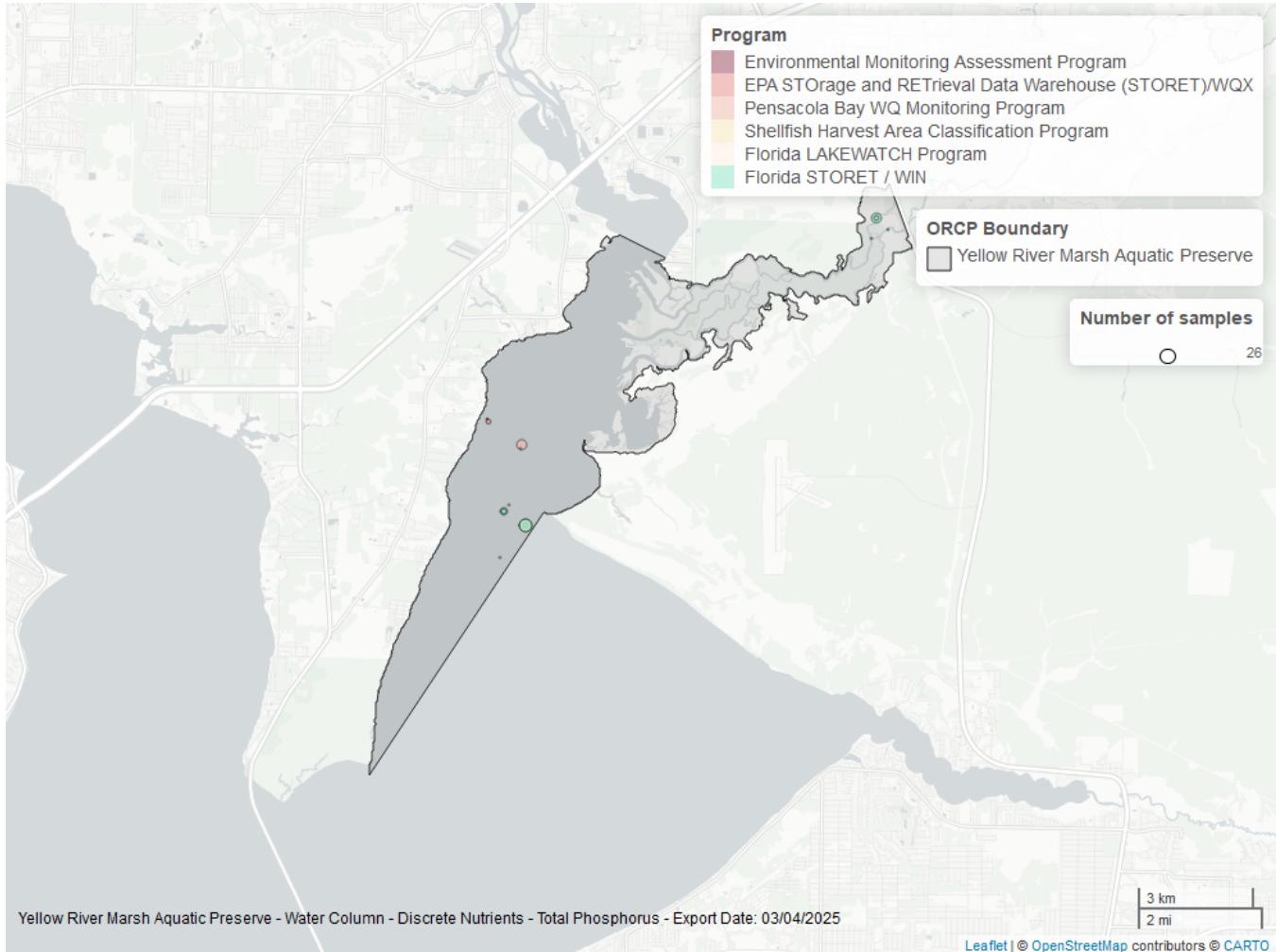


Figure 18: Map showing location of discrete water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 23: Programs contributing data for Total Phosphorus

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
5002	57	2007	2020
540	22	2016	2022
505	18	2002	2003
103	6	2004	2021
514	3	2001	2001
115	1	2004	2004

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX⁴

115 - Environmental Monitoring Assessment Program⁵

505 - Pensacola Bay Water Quality Monitoring Program¹

514 - Florida LAKEWATCH Program⁷

540 - Shellfish Harvest Area Classification Program²

5002 - Florida STORET / WIN³

Turbidity - Discrete

Seasonal Kendall-Tau Trend Analysis

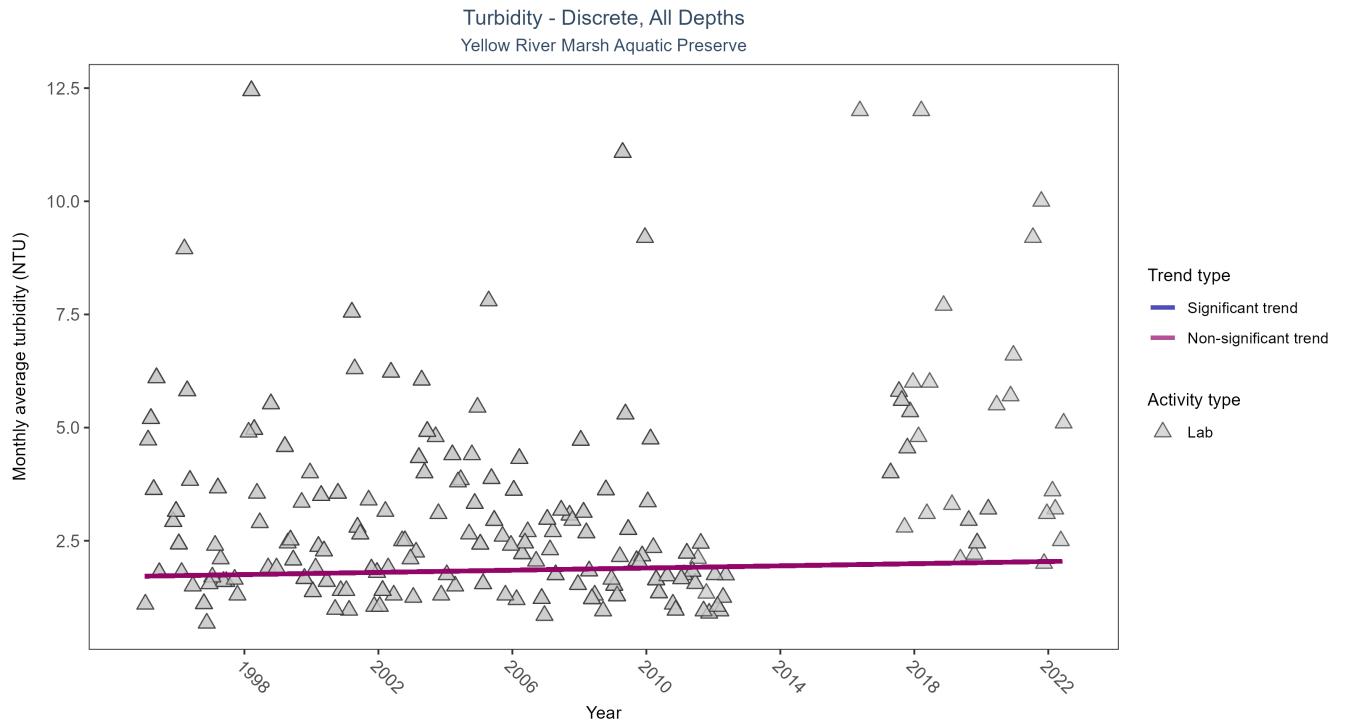


Figure 19: Scatter plot of monthly average turbidity over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only turbidity values measured in the laboratory (triangles) are included in the plot.

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	589	25	1995 - 2022	2.47	0.0753	1.7174	0.012	0.5284

Turbidity showed no detectable trend between 1995 and 2022.

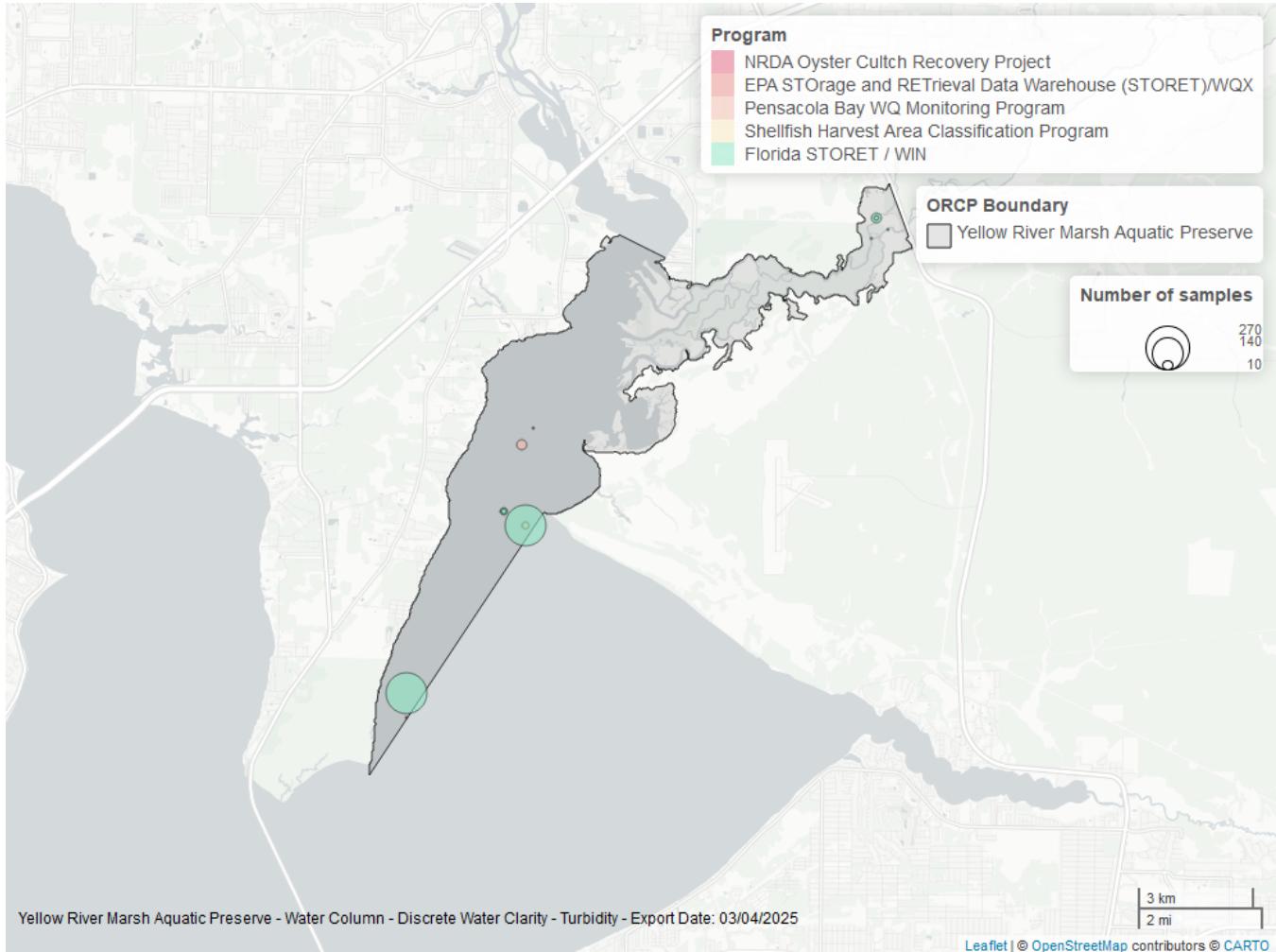


Figure 20: Map showing location of discrete water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 25: Programs contributing data for Turbidity

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
5002	569	1995	2020
505	13	2009	2012
540	12	2019	2022
103	5	1977	2021
4044	2	2023	2023

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX⁴

505 - Pensacola Bay Water Quality Monitoring Program¹

540 - Shellfish Harvest Area Classification Program²

4044 - NRDA Oyster Cutch Recovery Project¹⁰

5002 - Florida STORET / WIN³

Water Temperature - Discrete

Seasonal Kendall-Tau Trend Analysis

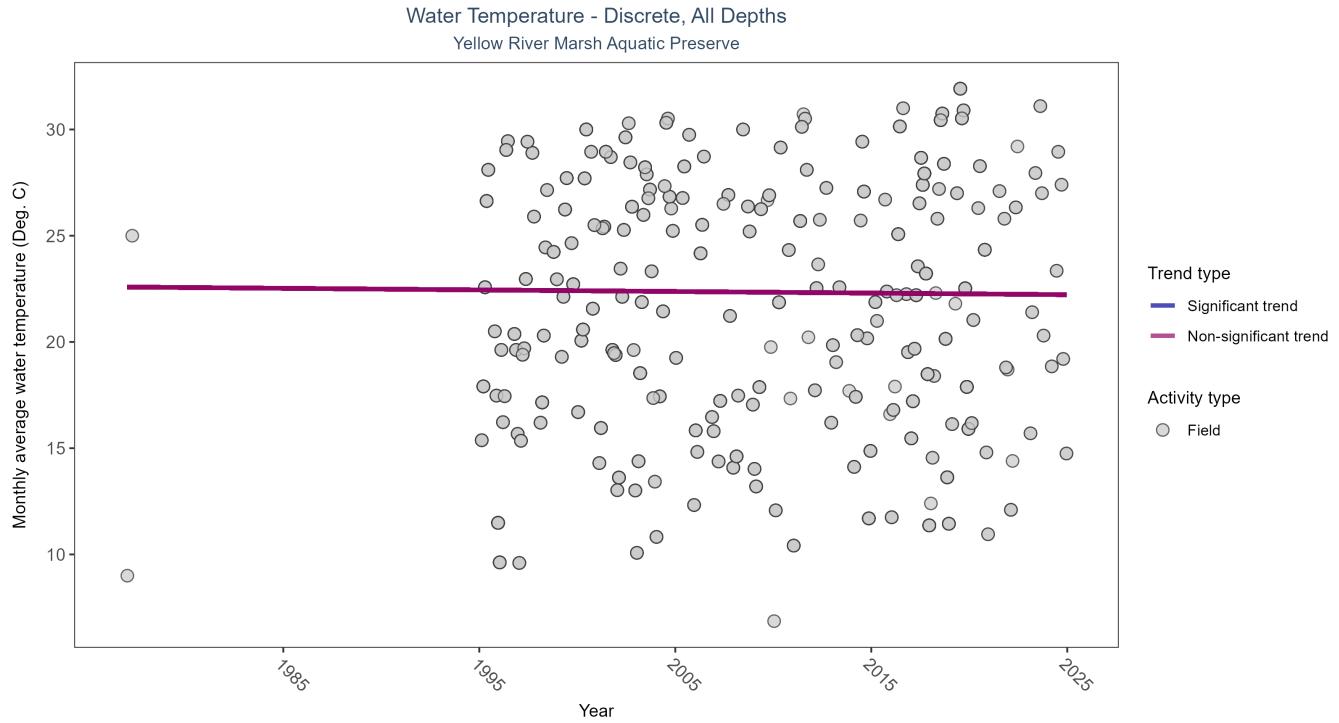


Figure 21: Scatter plot of monthly average water temperature over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only water temperature measurements taken in the field (circles) are included in 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	1244	31	1977 - 2024	22	-0.0088	22.5846	-0.0075	0.6898

Water temperature showed no detectable trend between 1977 and 2024.

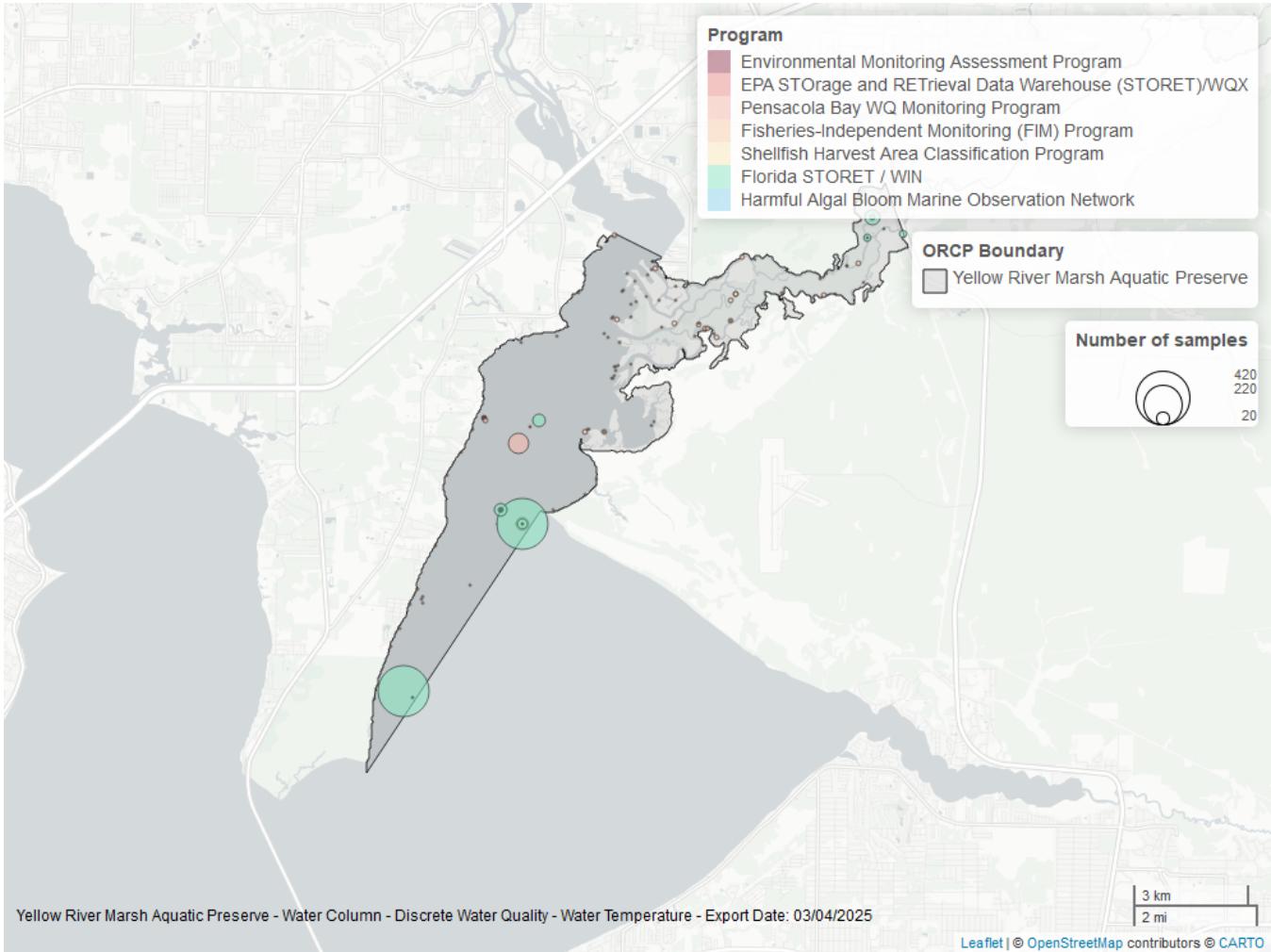


Figure 22: Map showing location of discrete water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 27: Programs contributing data for Water Temperature

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
5002	960	1995	2024
69	182	2003	2019
505	67	2002	2012
540	21	2016	2022
103	7	1977	2021
95	4	2000	2017
115	3	2004	2004

Program names:

- 69 - Fisheries-Independent Monitoring (FIM) Program⁸
- 95 - Harmful Algal Bloom Marine Observation Network⁹
- 103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX⁴
- 115 - Environmental Monitoring Assessment Program⁵
- 505 - Pensacola Bay Water Quality Monitoring Program¹

540 - Shellfish Harvest Area Classification Program²

5002 - Florida STORET / WIN³

Water Quality - Continuous

The following files were used in the continuous analysis:

- *Combined_WQ_WC_NUT_cont_Dissolved_Oxygen_NW-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_cont_Dissolved_Oxygen_Saturation_NW-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_cont_pH_NW-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_cont_Salinity_NW-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_cont_Turbidity_NW-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_cont_Water_Temperature_NW-2025-Mar-06.txt*

Continuous monitoring locations in Yellow River Marsh 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>
467	YRMAP1	10	TRUE	DO , DOS , pH , Sal , Turb , TempW
505	P11	4	FALSE	Turb
505	P11	11	TRUE	DO , DOS , Sal , TempW

Program names:

467 - Yellow River Marsh Aquatic Preserve Continuous Water Quality Monitoring¹¹

505 - Pensacola Bay Water Quality Monitoring Program¹

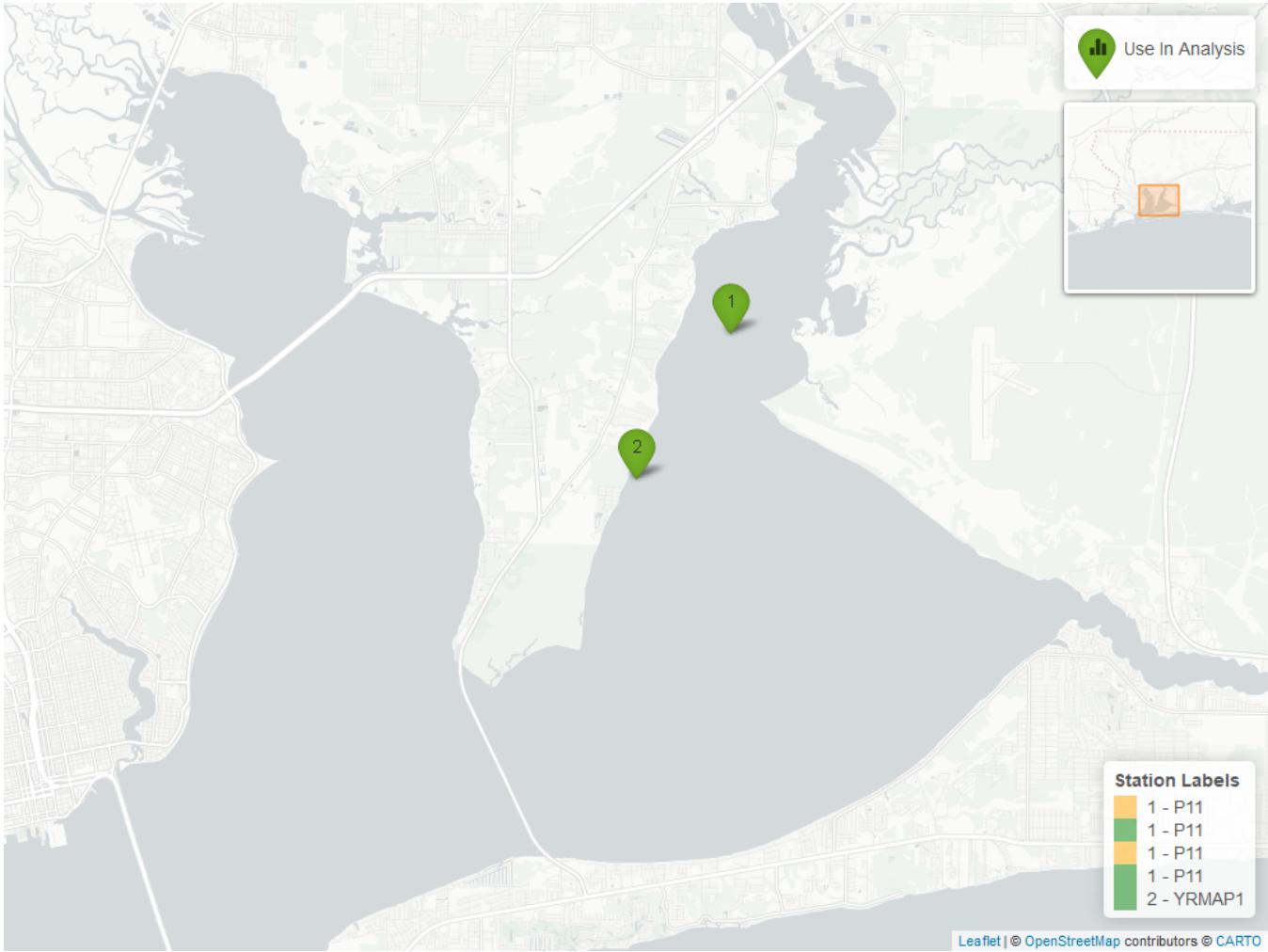


Figure 23: Map showing continuous water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. Sites marked as *Use In Analysis* (green) are featured in this report.

Dissolved Oxygen - Continuous

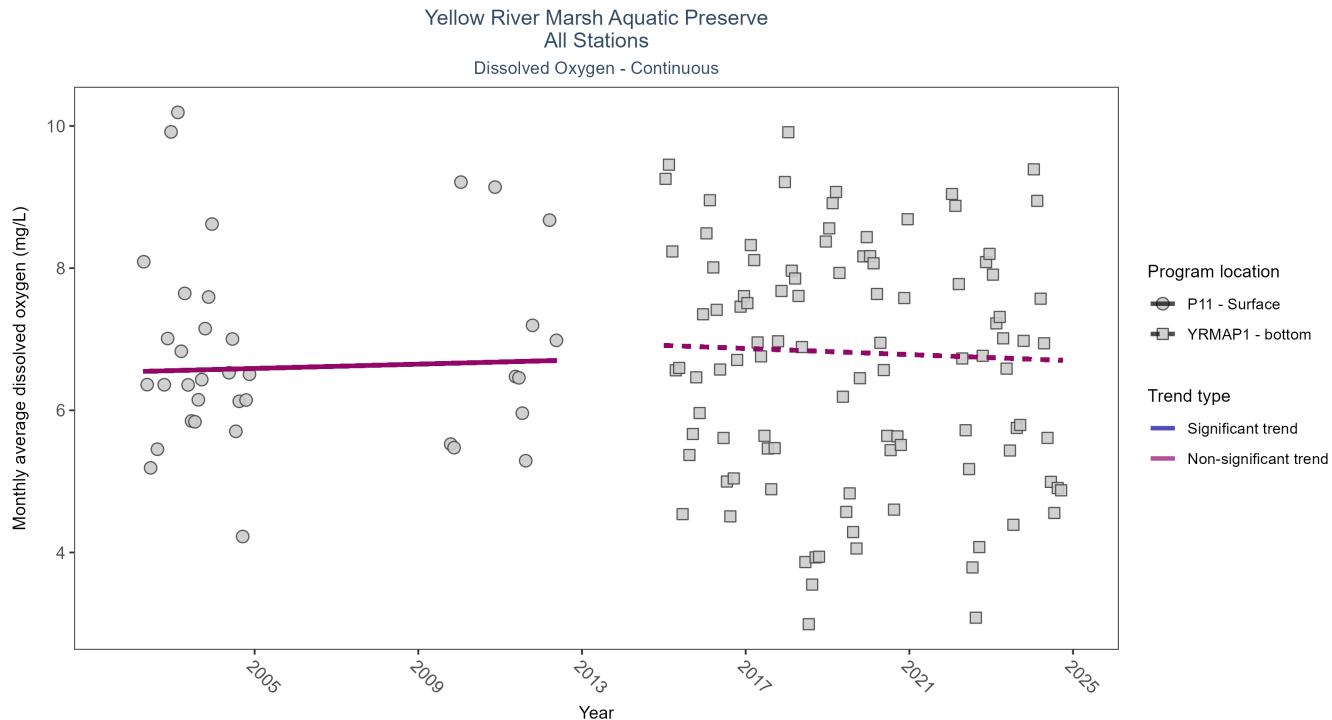


Figure 24: Scatter plot of monthly average dissolved oxygen over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

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
YRMAP1	No significant trend	250145	9	2015 - 2024	6.90	-0.07	6.91	-0.02	0.28
P11	No significant trend	131	7	2002 - 2012	6.37	0.04	6.54	0.02	0.49

No detectable change in monthly average dissolved oxygen was observed at two locations.

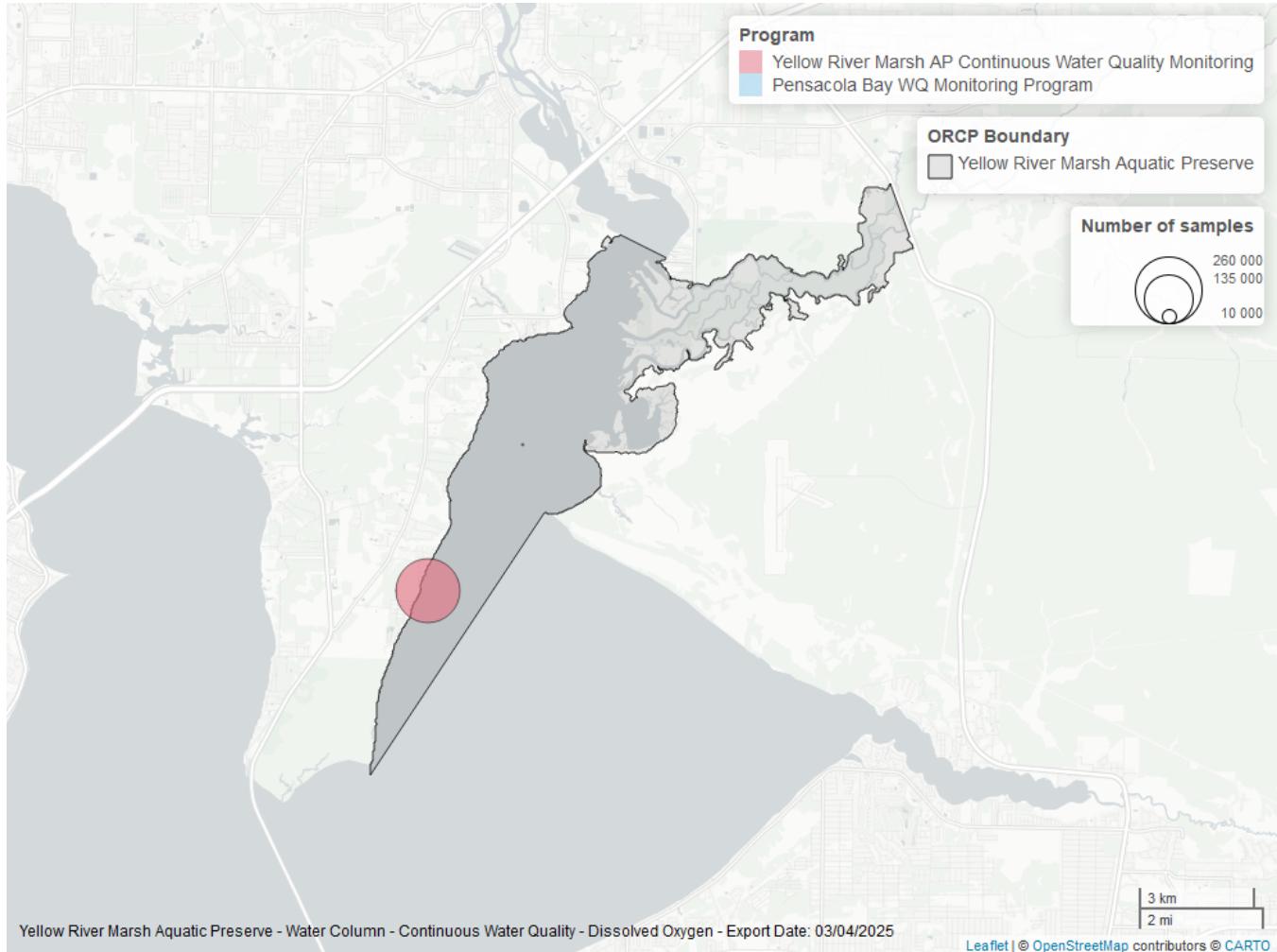


Figure 25: Map showing location of dissolved oxygen continuous water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Dissolved Oxygen Saturation - Continuous

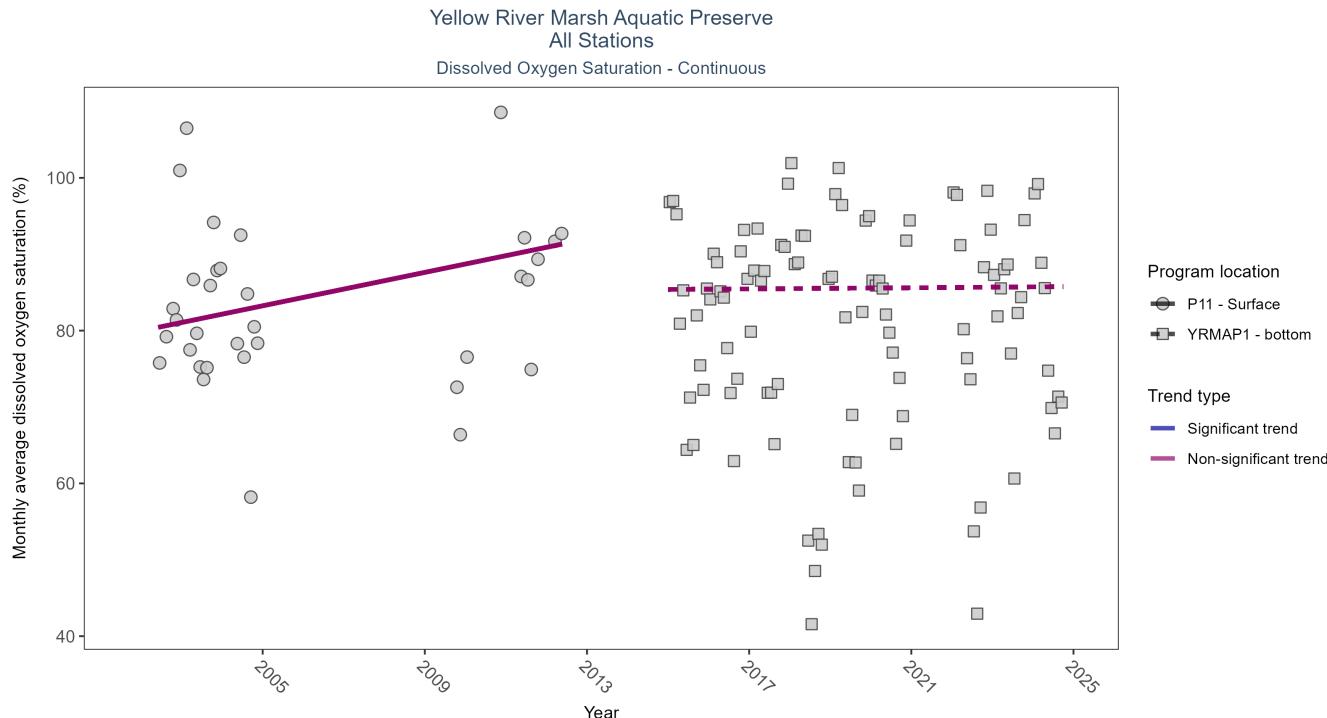


Figure 26: Scatter plot of monthly average dissolved oxygen saturation over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

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
YRMAP1	No significant trend	256413	9	2015 - 2024	86.70	0.04	85.39	0.04	0.82
P11	No significant trend	126	7	2002 - 2012	79.93	0.09	79.97	1.09	0.71

No detectable change in monthly average dissolved oxygen saturation was observed at two locations.

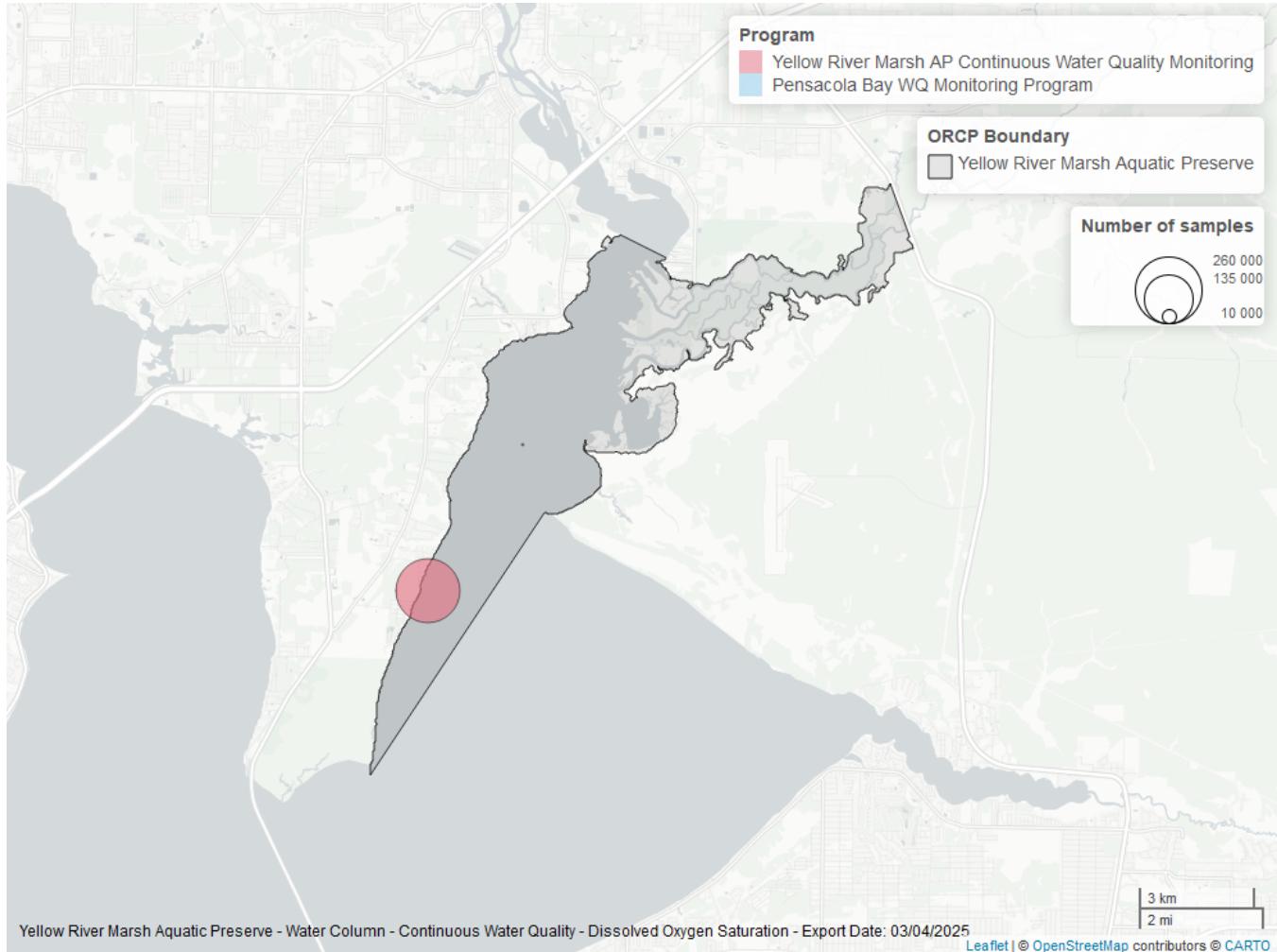


Figure 27: Map showing location of dissolved oxygen saturation continuous water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

pH - Continuous

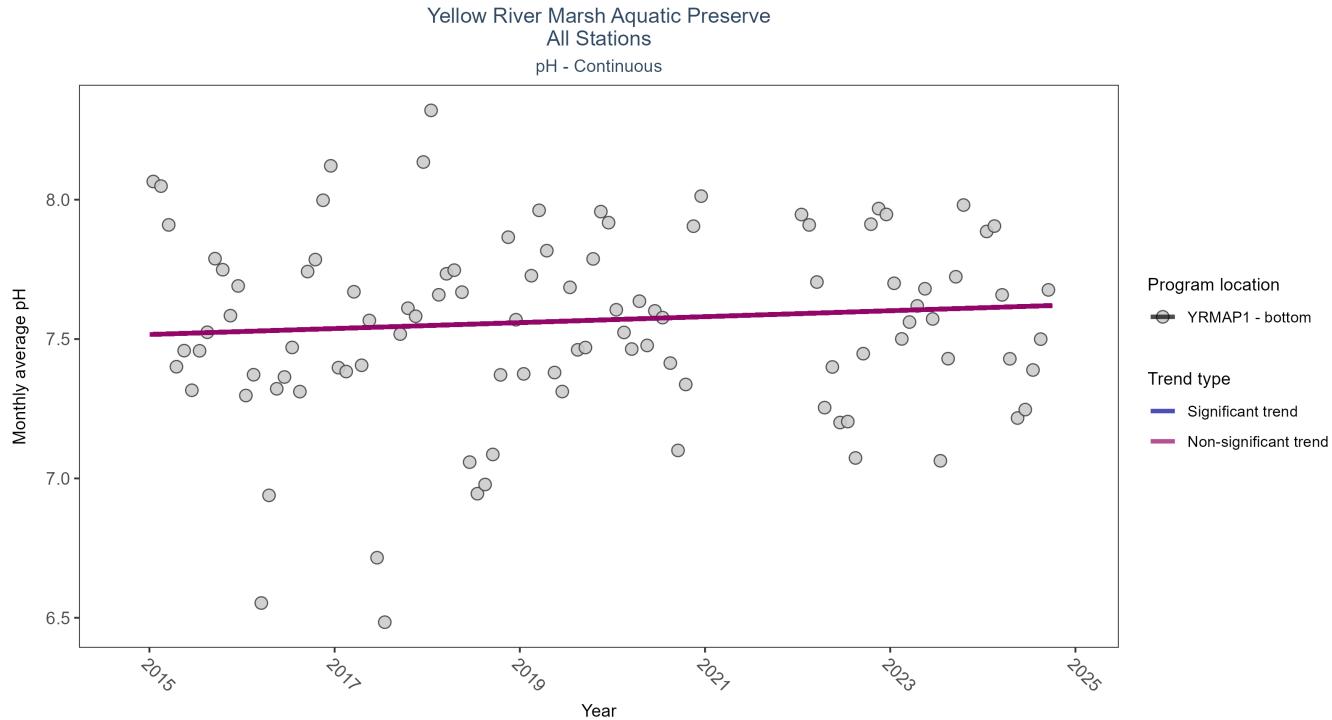


Figure 28: Scatter plot of monthly average pH over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

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
YRMAP1	No significant trend	265169	9	2015 - 2024	7.6	0.08	7.52	0.01	0.38

No detectable change in monthly average pH was observed at one location.

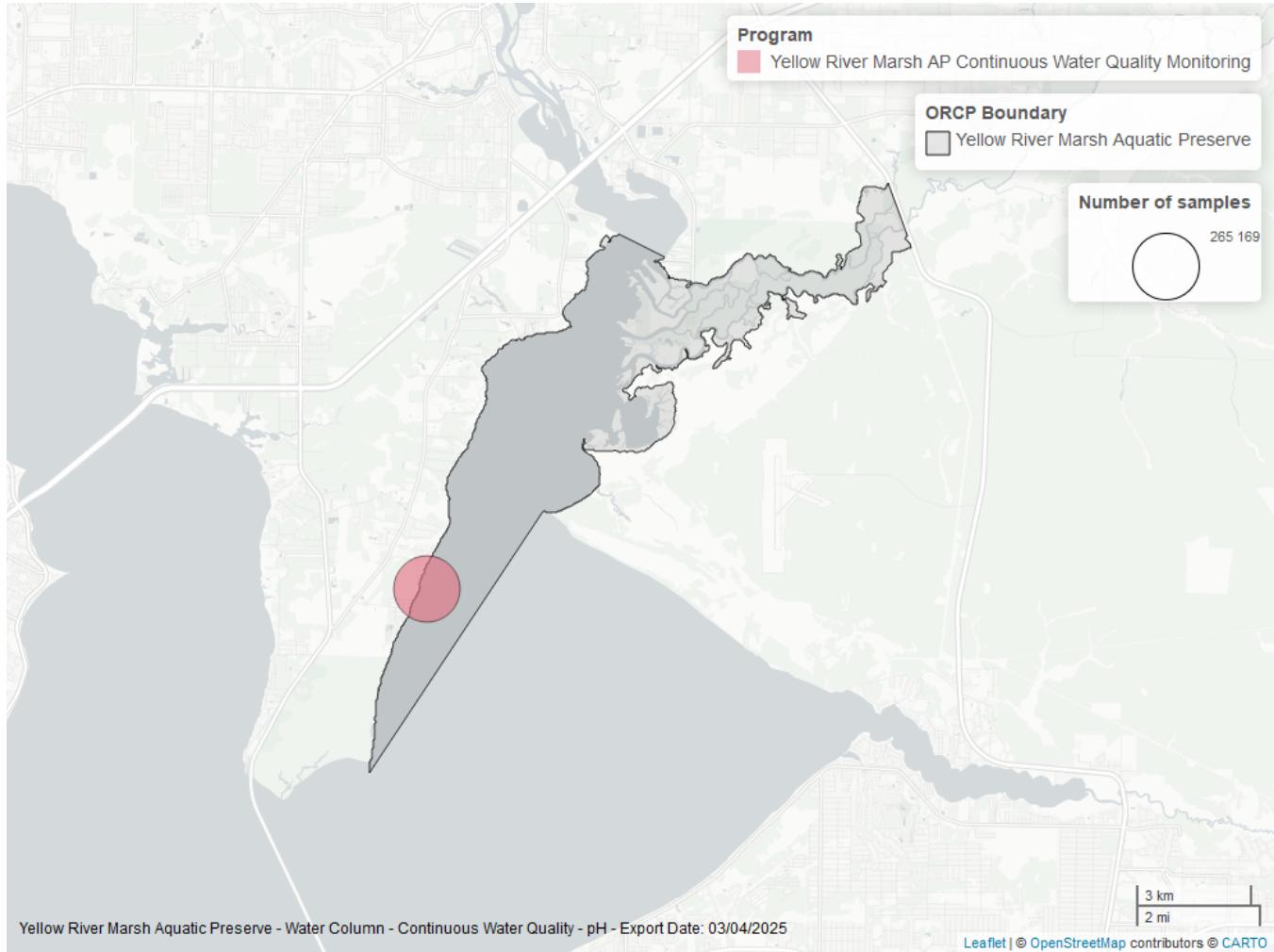


Figure 29: Map showing location of ph continuous water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Salinity - Continuous

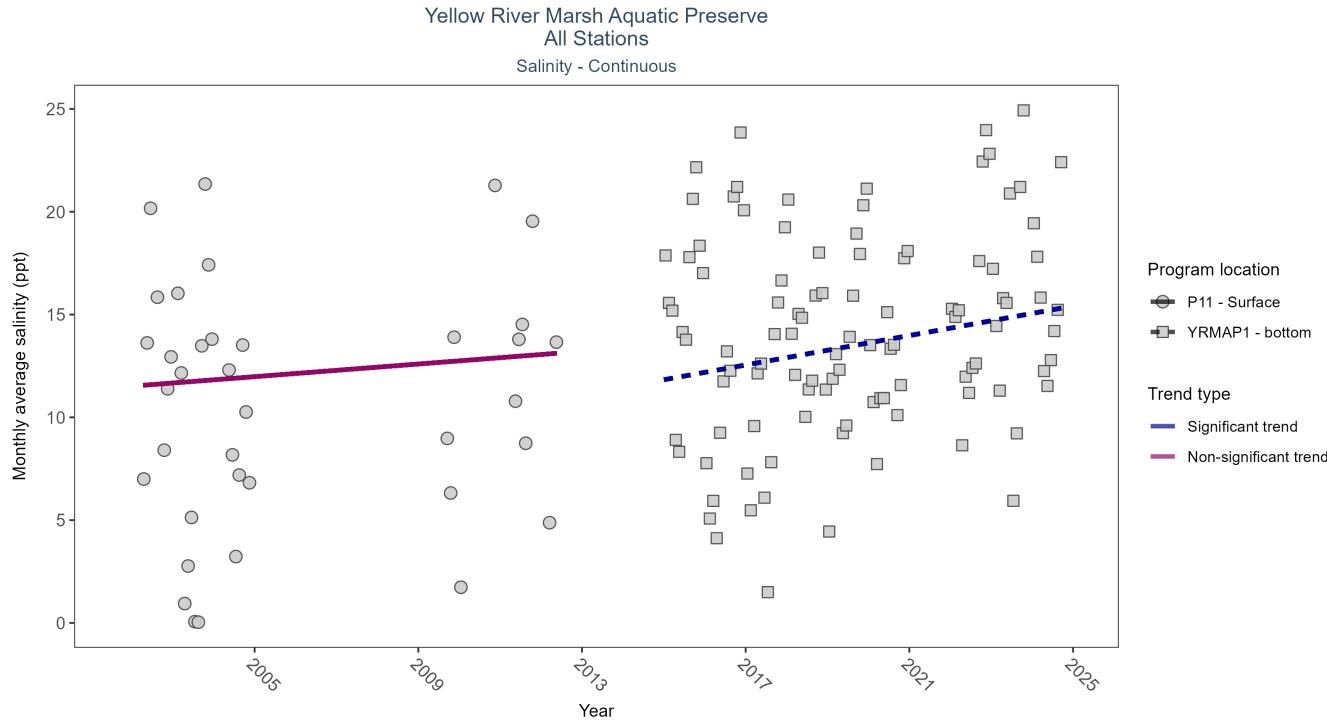


Figure 30: Scatter plot of monthly average salinity over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

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
YRMAP1	Significantly increasing trend	266823	9	2015 - 2024	14.20	0.22	11.83	0.36	0.01
P11	No significant trend	136	7	2002 - 2012	10.05	0.06	11.52	0.15	0.65

At one program location, monthly average salinity increased by 0.36 ppt per year. No detectable change in monthly average salinity was observed at one location.

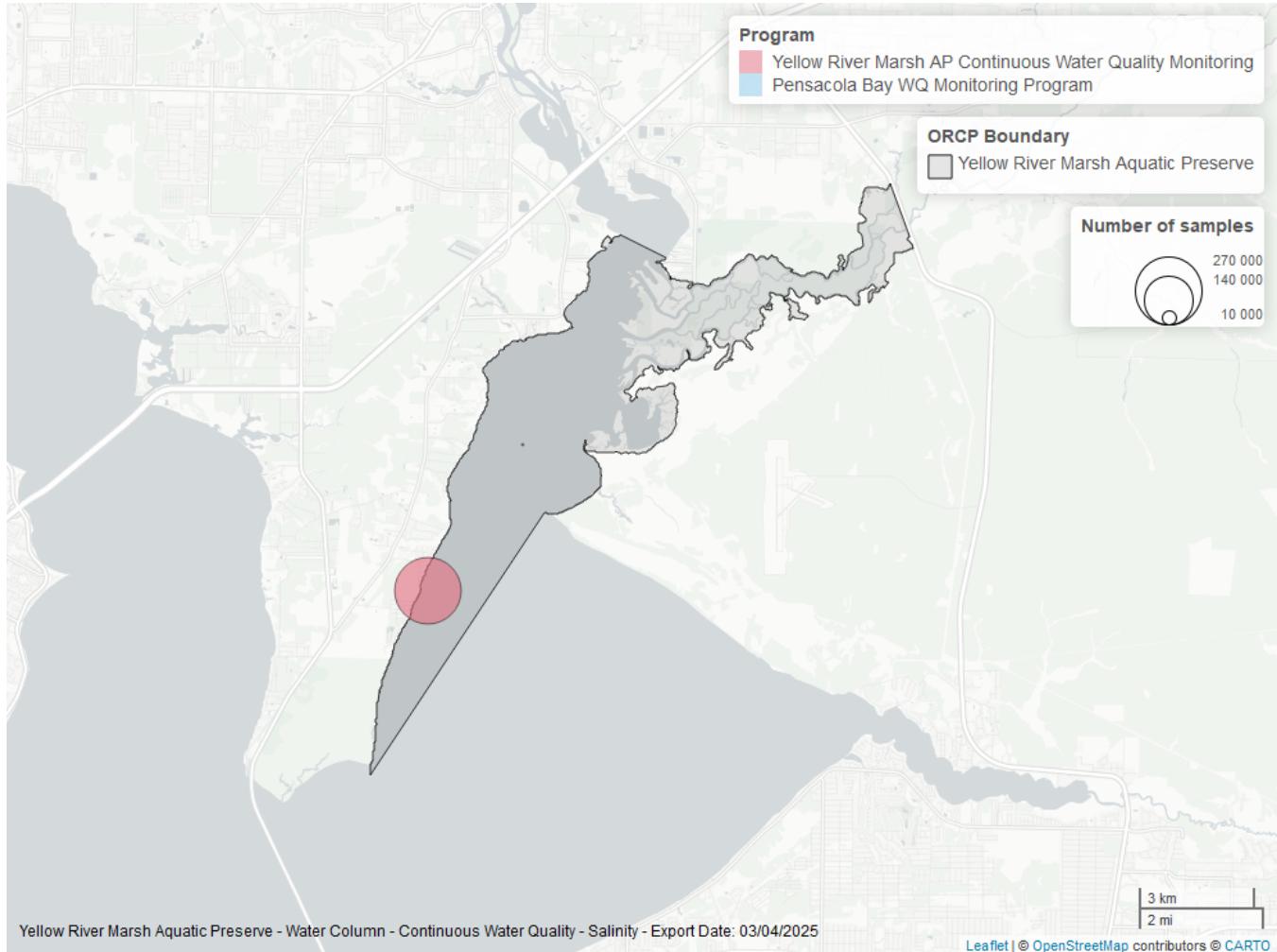


Figure 31: Map showing location of salinity continuous water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Turbidity - Continuous

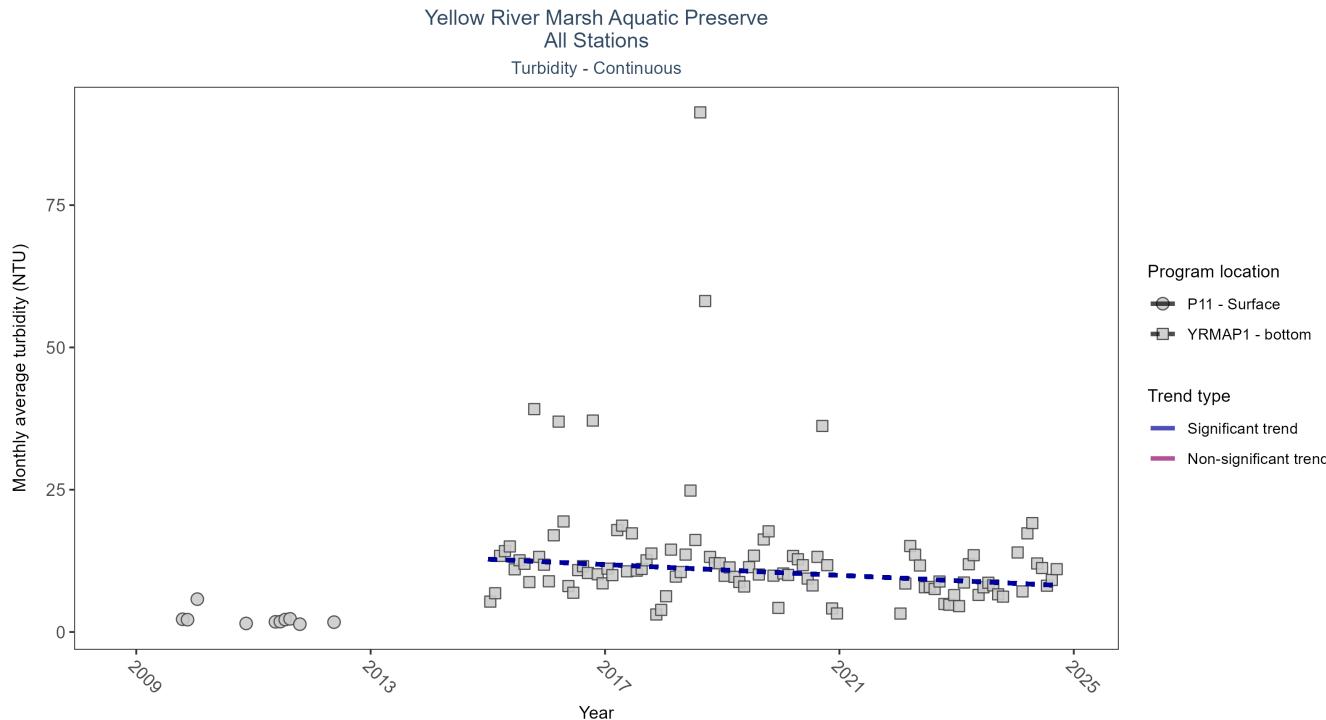


Figure 32: Scatter plot of monthly average turbidity over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

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
YRMAP1	Significantly decreasing trend	278916	9	2015 - 2024	6	-0.26	12.79	-0.47	0
P11	Insufficient data to calculate trend	37	4	2009 - 2012	2	-	-	-	-

At one program location, monthly average turbidity decreased by 0.47 NTU per year. There was insufficient data to fit a model for one location.

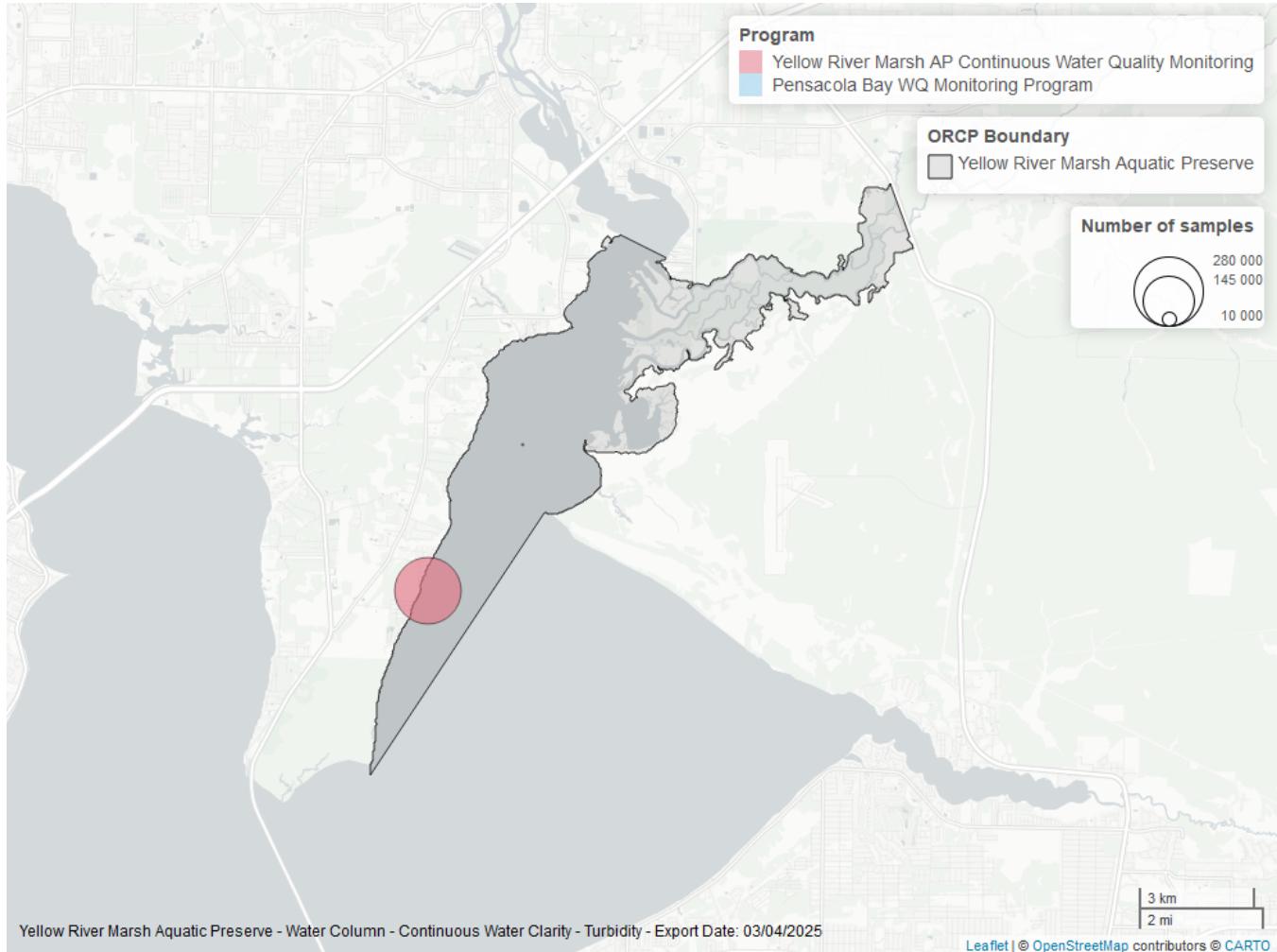


Figure 33: Map showing location of turbidity continuous water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Water Temperature - Continuous

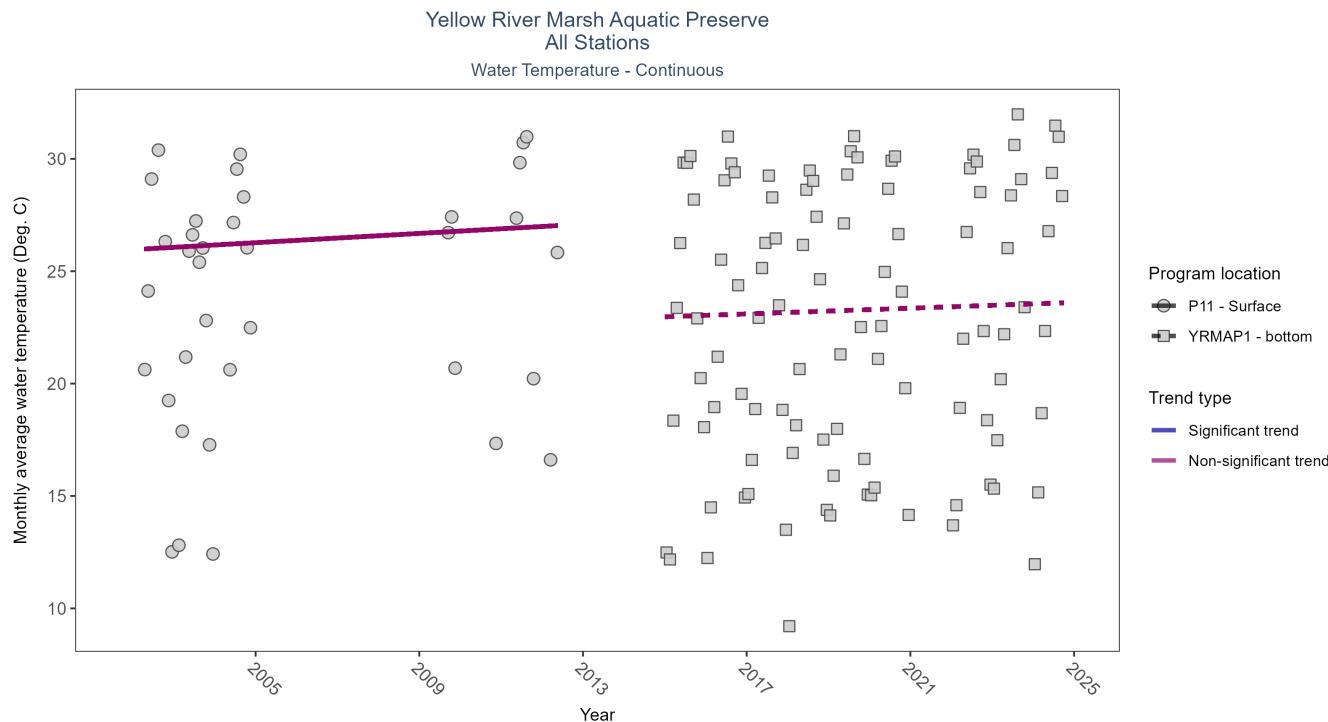


Figure 34: Scatter plot of monthly average water temperature over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

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
YRMAP1	No significant trend	291592	9	2015 - 2024	23.20	0.08	22.97	0.06	0.24
P11	No significant trend	136	7	2002 - 2012	26.22	0.13	25.96	0.10	0.50

No detectable change in monthly average water temperature was observed at two locations.

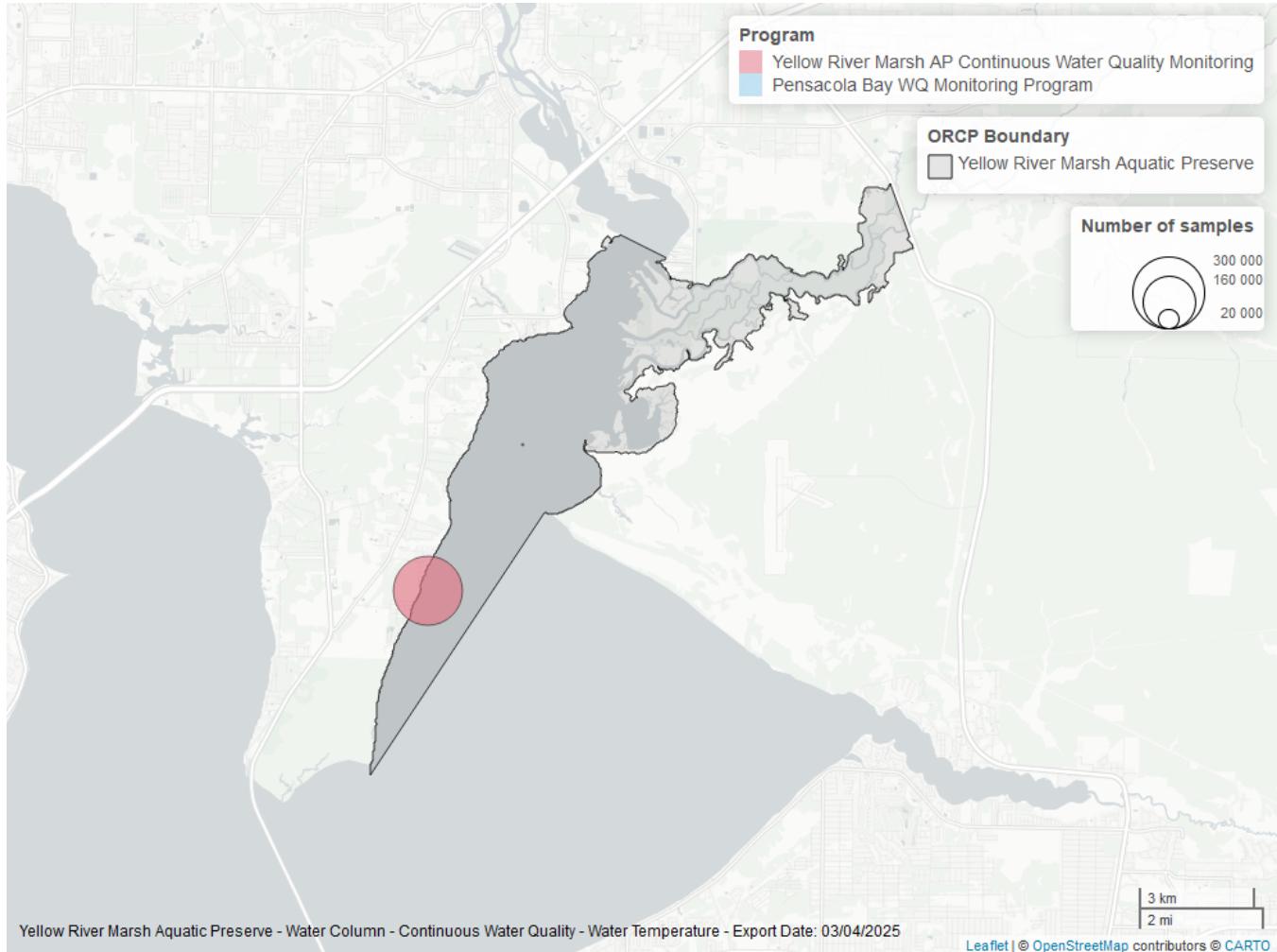


Figure 35: Map showing location of water temperature continuous water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Oyster

The data file used is: All_OYSTER_Parameters-2025-Apr-24.txt

Density

Restored

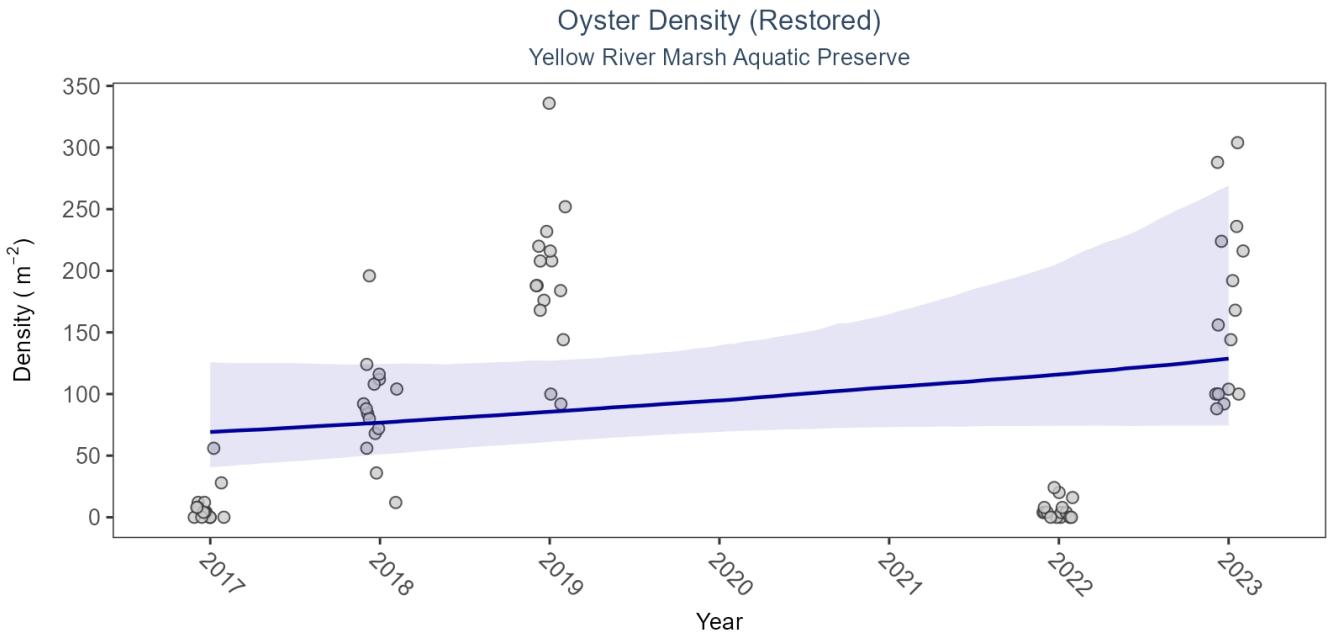


Figure 36: Scatter plot of oyster density over time. If the time series included five or more years with observations, an estimated trend (blue line) and a 95% credible interval (purple band) may also be plotted. Data points are jittered horizontally to reduce overlap.

Table 35: Model results for Oyster Density - Restored

Shell Type	Habitat Type	Trend Status	Estimate	Standard Error	Credible Interval
Live Oysters	Restored	Significantly increasing trend	9.92	21.37	5.64 to 23.87

For natural reefs, there was insufficient data to calculate a trend for density. For restored reefs, density increased by an average of 9.92 oysters per square meter per year.

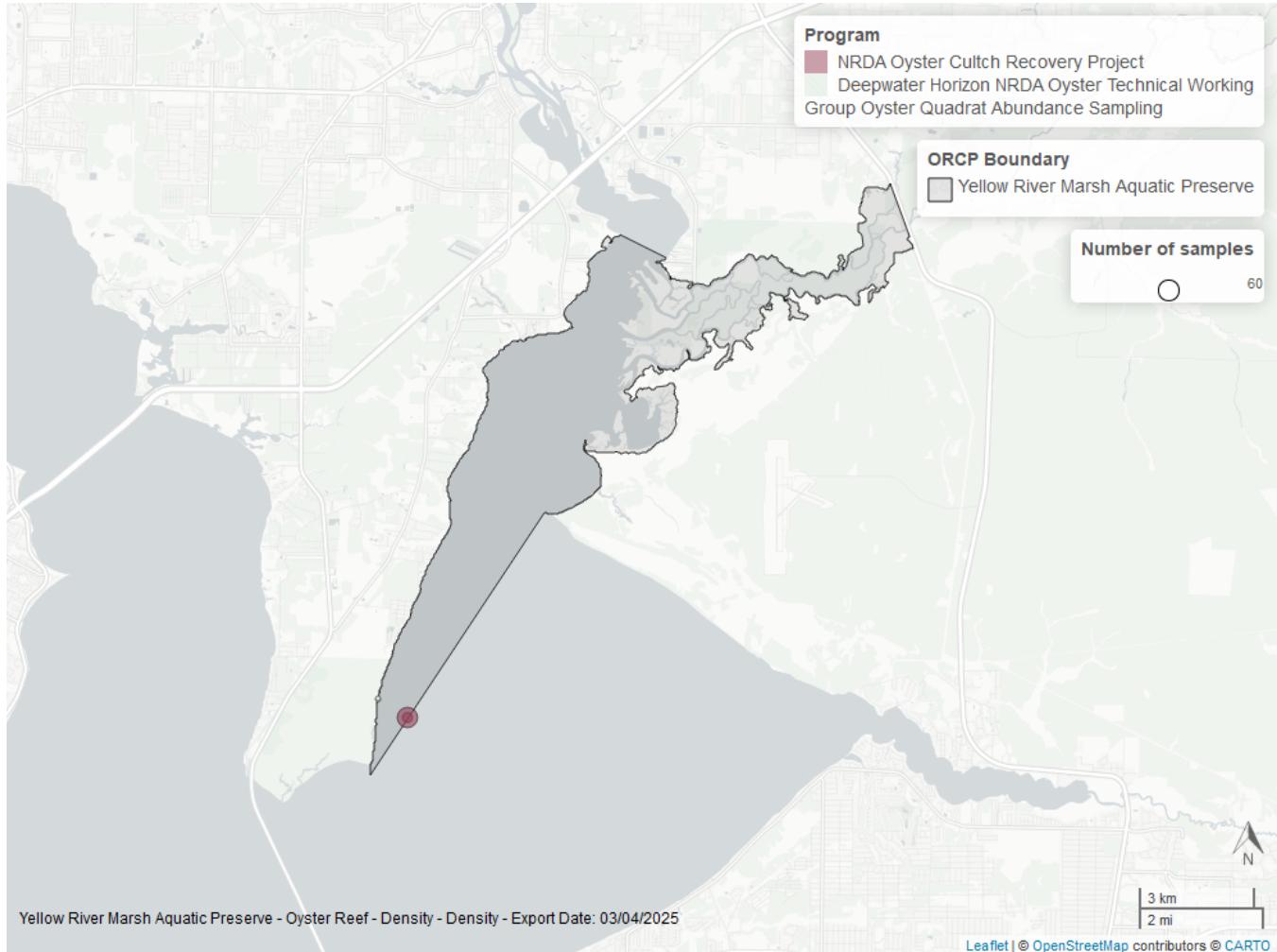


Figure 37: Map showing location of oyster density sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Percent Live

Restored

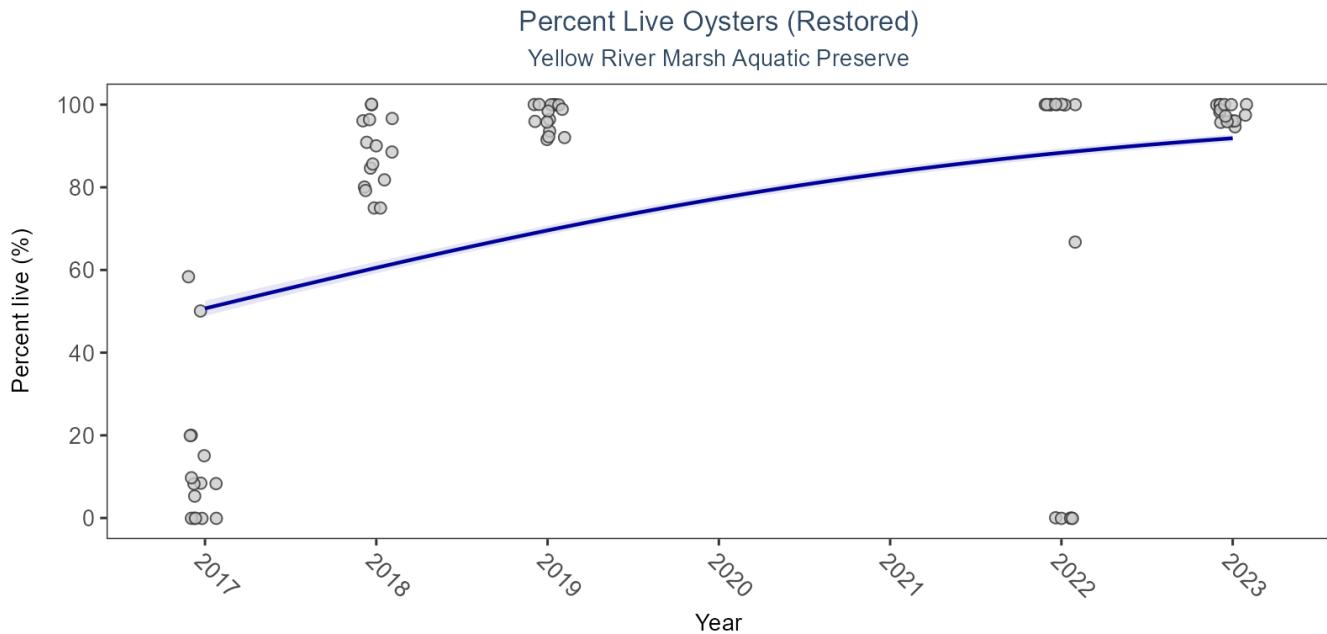


Figure 38: Scatter plot of percent live oysters over time. If the time series included five or more years with observations, an estimated trend (blue line) and a 95% credible interval (purple band) may also be plotted. Data points are jittered horizontally to reduce overlap.

Table 36: Model results for Oyster Percent Live - Restored

<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	Restored	Significantly increasing trend	6.86	0.6	7 to 6.7

For restored reefs, percent live cover increased by an average of 6.86% per year.

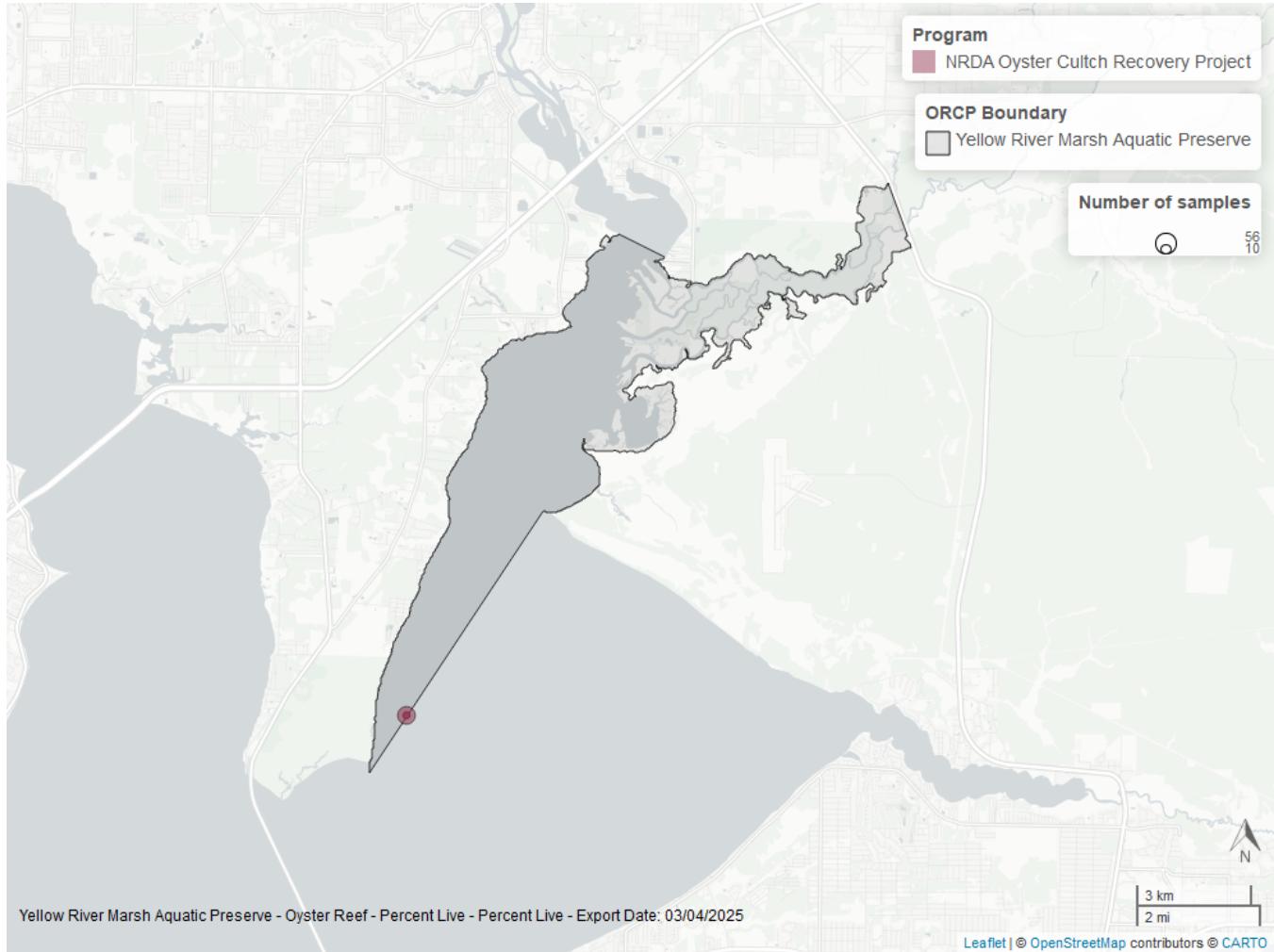


Figure 39: Map showing location of oyster percent live sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Shell Height

Restored

Oyster Size Class (Restored)
Yellow River Marsh Aquatic Preserve

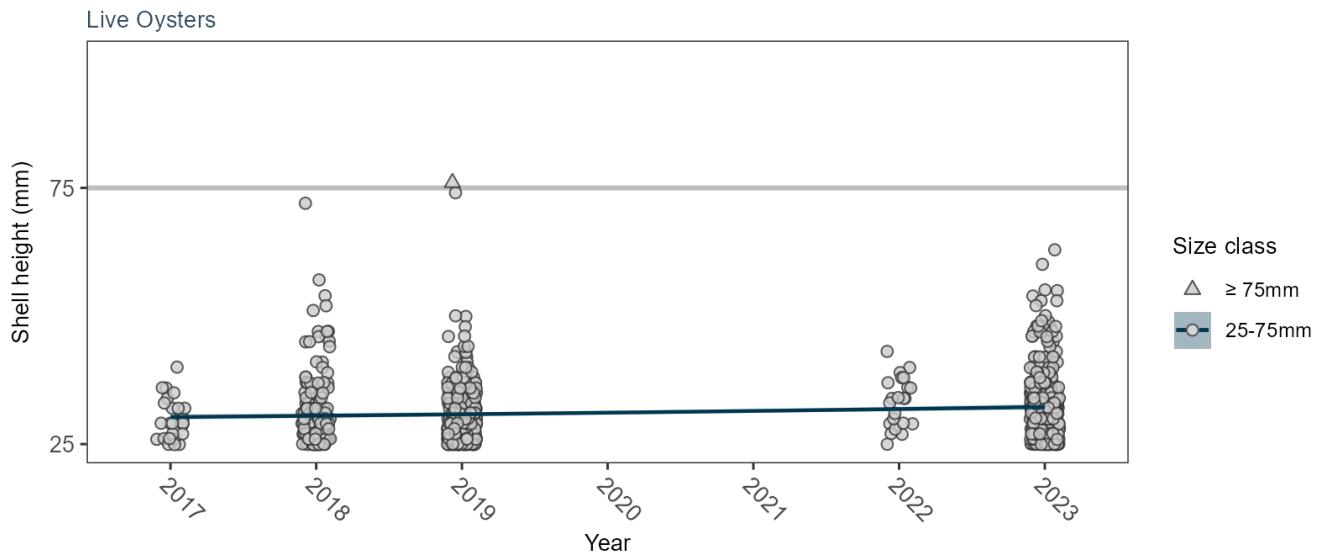


Table 37: Model results for Oyster Shell Height - Restored

Shell Type	SizeClass	Habitat Type	Trend Status	Estimate	Standard Error	Credible Interval
Live Oysters	>75mm	Restored	-	-	-	-
Live Oysters	25-75mm	Restored	Significantly increasing trend	3.19	1.22	1.47 to 6.2
Live Oysters		Restored	-	-	-	-

For natural reefs, there was insufficient data to calculate a trend for live oysters in either the 25-75mm or the $\geq 75\text{mm}$ size class. For restored reefs, annual average live oyster shell height in the 25-75mm size class increased by 3.19mm per year, and there was insufficient data to calculate a trend for live oysters in the $\geq 75\text{mm}$ size class.

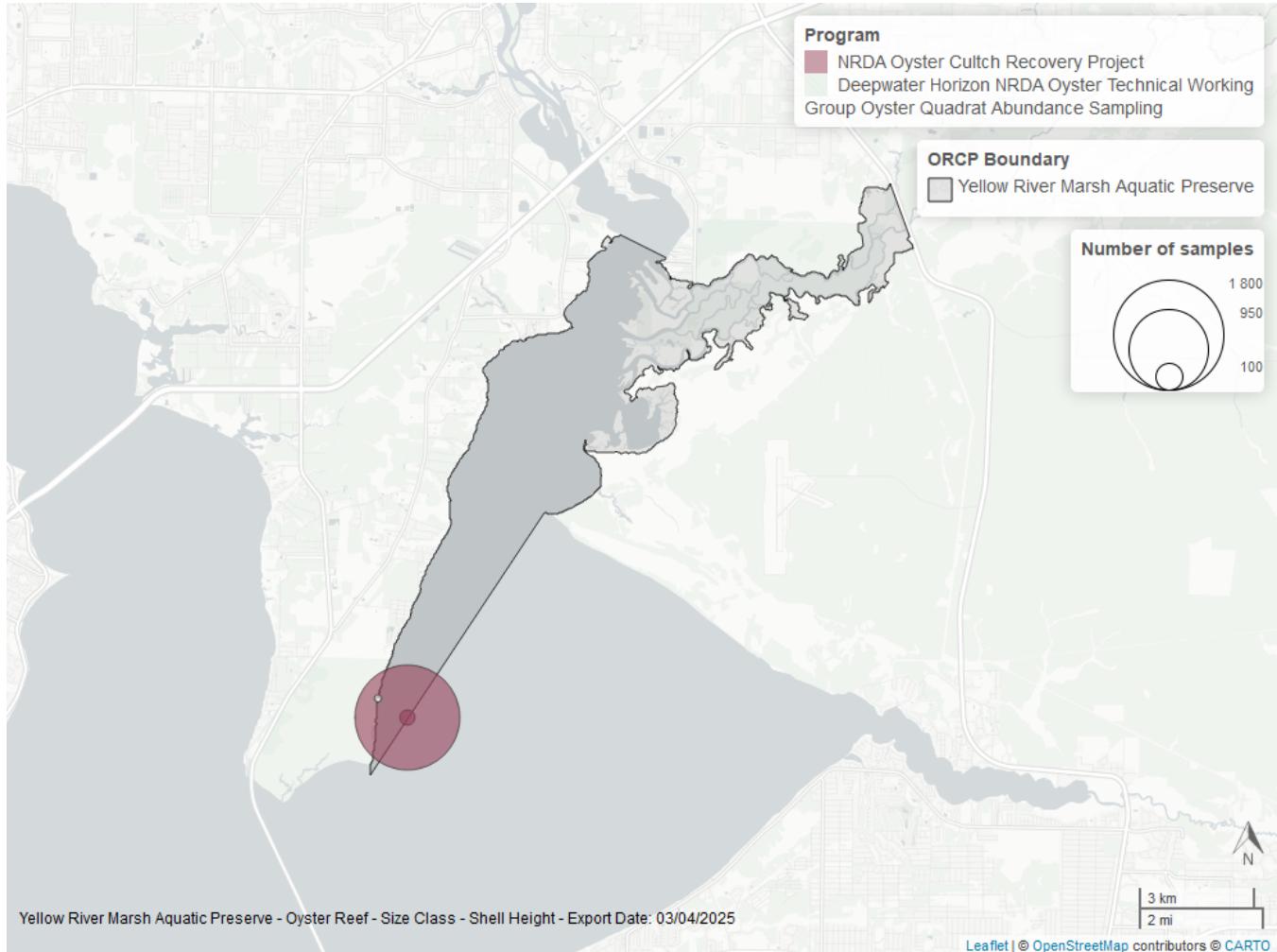


Figure 40: Map showing location of oyster shell height sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

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1. U.S. Environmental Protection Agency (EPA); Gulf Ecology Division. [Pensacola Bay Water Quality Monitoring Program](#). (2016).
2. Florida Department of Agriculture and Consumer Services (FDACS) - Division of Aquaculture. [Shellfish Harvest Area Classification Program](#). (2022).
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8. Florida Fish and Wildlife Conservation Commission (FWC). [Fisheries-Independent Monitoring \(FIM\) Program](#). (2022).
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11. Florida Department of Environmental Protection (DEP); Office of Resilience and Coastal Protection (RCP); Northwest Florida Aquatic Preserves. [Yellow River Marsh Aquatic Preserve Continuous Water Quality Monitoring](#). (2024).