Yellow River Marsh Aquatic Preserve

SEACAR Habitat Analyses

Last compiled on 08 October, 2025

Contents

Funding & Acknowledgements

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Threshold Filtering

Threshold filters, following the guidance of Florida Department of Environmental Protection's (*FDEP*) Division of Environmental Assessment and Restoration (*DEAR*) are used to exclude specific results values from the SEACAR Analysis. Based on the threshold filters, Quality Assurance / Quality Control (*QAQC*) Flags are inserted into the *SEACAR_QAQCFlagCode* and *SEACAR_QAQC_Description* columns of the export data. The *Include* column indicates whether the *QAQC* Flag will also indicate that data are excluded from analysis. No data are excluded from the data export, but the analysis scripts can use the *Include* column to exclude data (1 to include, 0 to exclude).

Table 1: Continuous Water Quality threshold values

Parameter Name	*Units*	*Low Threshold*	*High Threshold*
Dissolved Oxygen	mg/L	-0.000001	50
Dissolved Oxygen Saturation	%	-0.000001	500
Salinity	ppt	-0.000001	70
Turbidity	NTU	-0.000001	4000
Water Temperature	Degrees C	-5.000000	45
pH	None	2.000000	14

Table 2: Discrete Water Quality threshold values

Parameter Name	*Units*	*Low Threshold*	*High Threshold*
Ammonia, Un-ionized (NH3)	mg/L	-	-
Ammonium, Filtered (NH4)	mg/L	-	-
Chlorophyll a, Corrected for Pheophytin	ug/L	-	-
Chlorophyll a, Uncorrected for Pheophytin	ug/L	-	-
Colored Dissolved Organic Matter	PCU	-	-

Parameter Name	*Units*	*Low Threshold*	*High Threshold*
Dissolved Oxygen	mg/L	-0.000001	25
Dissolved Oxygen Saturation	%	-0.000001	310
Fluorescent Dissolved Organic Matter	QSE	-	-
Light Extinction Coefficient	m^-1	-	-
NO2+3, Filtered	mg/L	-	-
Nitrate (NO3)	mg/L	-	-
Nitrite (NO2)	mg/L	-	-
Nitrogen, organic	mg/L	-	-
Phosphate, Filtered (PO4)	mg/L	-	-
Salinity	ppt	-0.000001	70
Secchi Depth	m	0.000001	50
Specific Conductivity	mS/cm	0.005000	100
Total Kjeldahl Nitrogen	mg/L	-	-
Total Nitrogen	mg/L	-	-
Total Nitrogen	mg/L	-	-
Total Phosphorus	mg/L	-	-
Total Suspended Solids	mg/L	-	-
Turbidity	NTU	-	-
Water Temperature	Degrees C	3.000000	40
pH	None	2.000000	13

Table 3: Quality Assurance Flags inserted based on threshold checks listed in Table 1 and 2

SEACAR QAQC Description	*Include*	*SEACAR QAQCFlagCode*
Exceeds maximum threshold	0	2Q
Below minimum threshold	0	4Q
Within threshold tolerance	1	6Q
No defined thresholds for this parameter	1	7Q

Value Qualifiers

Value qualifier codes included within the data are used to exclude certain results from the analysis. The data are retained in the data export files, but the analysis uses the *Include* column to filter the results.

STORET and WIN value qualifier codes

Value qualifier codes from *STORET* and *WIN* data are examined with the database and used to populate the *Include* column in data exports.

Table 4: Value Qualifier codes excluded from analysis

Qualifier Source	*Value Qualifier*	*Include*	*MDL*	*Description*
STORET-WIN	H	0	0	Value based on field kit determination; results may not be accurate
STORET-WIN	J	0	0	Estimated value
STORET-WIN	V	0	0	Analyte was detected at or above method detection limit
STORET-WIN	Y	0	0	Lab analysis from an improperly preserved sample; data may be inaccurate

Discrete Water Quality Value Qualifiers

The following value qualifiers are highlighted in the Discrete Water Quality section of this report. An exception is made for **Program 476** - *Charlotte Harbor Estuaries Volunteer Water Quality Monitoring Network* and data flagged with Value Qualifier **H** are included for this program only.

H - Value based on field kit determiniation; results may not be accurate. This code shall be used if a field screening test (e.g., field gas chromatograph data, immunoassay, or vendor-supplied field kit) was used to generate the value and the field kit or method has not been recognized by the Department as equivalent to laboratory methods.

I - The reported value is greater than or equal to the laboratory method detection limit but less than the laboratory practical quantitation limit.

Q - Sample held beyond the accepted holding time. This code shall be used if the value is derived from a sample that was prepared or analyzed after the approved holding time restrictions for sample preparation or analysis.

S - Secchi disk visible to bottom of waterbody. The value reported is the depth of the waterbody at the location of the Secchi disk measurement.

U - Indicates that the compound was analyzed for but not detected. This symbol shall be used to indicate that the specified component was not detected. The value associated with the qualifier shall be the laboratory method detection limit. Unless requested by the client, less than the method detection limit values shall not be reported

Systemwide Monitoring Program (SWMP) value qualifier codes

Value qualifier codes from the *SWMP* continuous program are examined with the database and used to populate the *Include* column in data exports. *SWMP* Qualifier Codes are indicated by *QualifierSource=SWMP*.

Table 5: SWMP Value Qualifier codes

Qualifier Source	*Value Qualifier*	*Include*	*Description*
SWMP	-1	1	Optional parameter not collected
SWMP	-2	0	Missing data
SWMP	-3	0	Data rejected due to QA/QC
SWMP	-4	0	Outside low sensor range
SWMP	-5	0	Outside high sensor range
SWMP	0	1	Passed initial QA/QC checks
SWMP	1	0	Suspect data
SWMP	2	1	Reserved for future use
SWMP	3	1	Calculated data: non-vented depth/level sensor correction for changes in barometric pressure
SWMP	4	1	Historical: Pre-auto QA/QC
SWMP	5	1	Corrected data

Water Column

The water column habitat extends from the water's surface to the bottom sediments, and it's where fish, dolphins, crabs and people swim! So much life makes its home in the water column that the health of marine and coastal ecosystems, as well as human economies, depend on the condition of this vulnerable habitat. Local patterns of rainfall, temperature, winds and currents can rapidly change the condition of the water column, while global influences such as El Niño/La Niña, large-scale fluctuation in sea temperatures and climate change can have long-term effects. Inputs from the prosperity of our day-to-day lives including farming, mining and forestry, and emissions from power generation, automobiles and water treatment can also alter the health of the water column. Acting alone or together, each input can have complex and lasting effects on habitats and ecosystems.

SEACAR evaluates water column health with several essential parameters. These include nutrient surveys of nitrogen and phosphorus, and water quality assessments of salinity, dissolved oxygen, pH, and water temperature. Water clarity is evaluated with Secchi depth, turbidity, levels of chlorophyll a, total suspended solids, and colored dissolved organic matter. Additionally, the richness of nekton is indicated by the abundance of free-swimming fishes and macroinvertebrates like crabs and shrimps.

Seasonal Kendall-Tau Analysis

Indicators must have a minimum of five to ten years, depending on the habitat, of data within the geographic range of the analysis to be included in the analysis. Ten years of data are required for discrete parameters, and five years of data are required for continuous parameters. If there are insufficient years of data, the number of years of data available will be noted and labeled as "insufficient data to conduct analysis". Further, for the preferred Seasonal Kendall-Tau test, there must be data from at least two months in common across at least two consecutive years within the RCP managed area being analyzed. Values that pass both of these tests will be included in the analysis and be labeled as *Use_In_Analysis* = **TRUE**. Any that fail either test will be excluded from the analyses and labeled as *Use_In_Analysis* = **FALSE**. The points for all Water Column plots displayed in this section are monthly averages. Trend significance will be denoted as "Significant Trend" (when $p < 0.05$), or "Non-significant Trend" (when $p >= 0.05$). Any parameters with insufficient data to perform Seasonal Kendall-Tau test will have their monthly averages plotted without a corresponding trend line.

Water Quality - Discrete

The following files were used in the discrete analysis:

- *Combined_WQ_WC_NUT_Chlorophyll_a_corrected_for_pheophytin-2025-Sep-04.txt*
- *Combined_WQ_WC_NUT_Chlorophyll_a_uncorrected_for_pheophytin-2025-Sep-04.txt*
- *Combined_WQ_WC_NUT_Colored_dissolved_organic_matter_CDOM-2025-Sep-04.txt*
- *Combined_WQ_WC_NUT_Dissolved_Oxygen-2025-Sep-04.txt*
- *Combined_WQ_WC_NUT_Dissolved_Oxygen_Saturation-2025-Sep-04.txt*
- *Combined_WQ_WC_NUT_pH-2025-Sep-04.txt*
- *Combined_WQ_WC_NUT_Salinity-2025-Sep-04.txt*
- *Combined_WQ_WC_NUT_Secchi_Depth-2025-Sep-04.txt*
- *Combined_WQ_WC_NUT_Total_Nitrogen-2025-Sep-04.txt*
- *Combined_WQ_WC_NUT_Total_Phosphorus-2025-Sep-04.txt*
- *Combined_WQ_WC_NUT_Total_Suspended_Solids_TSS-2025-Sep-04.txt*
- *Combined_WQ_WC_NUT_Turbidity-2025-Sep-04.txt*
- *Combined_WQ_WC_NUT_Water_Temperature-2025-Sep-04.txt*

Chlorophyll a, Corrected for Pheophytin - Discrete

Seasonal Kendall-Tau Trend Analysis

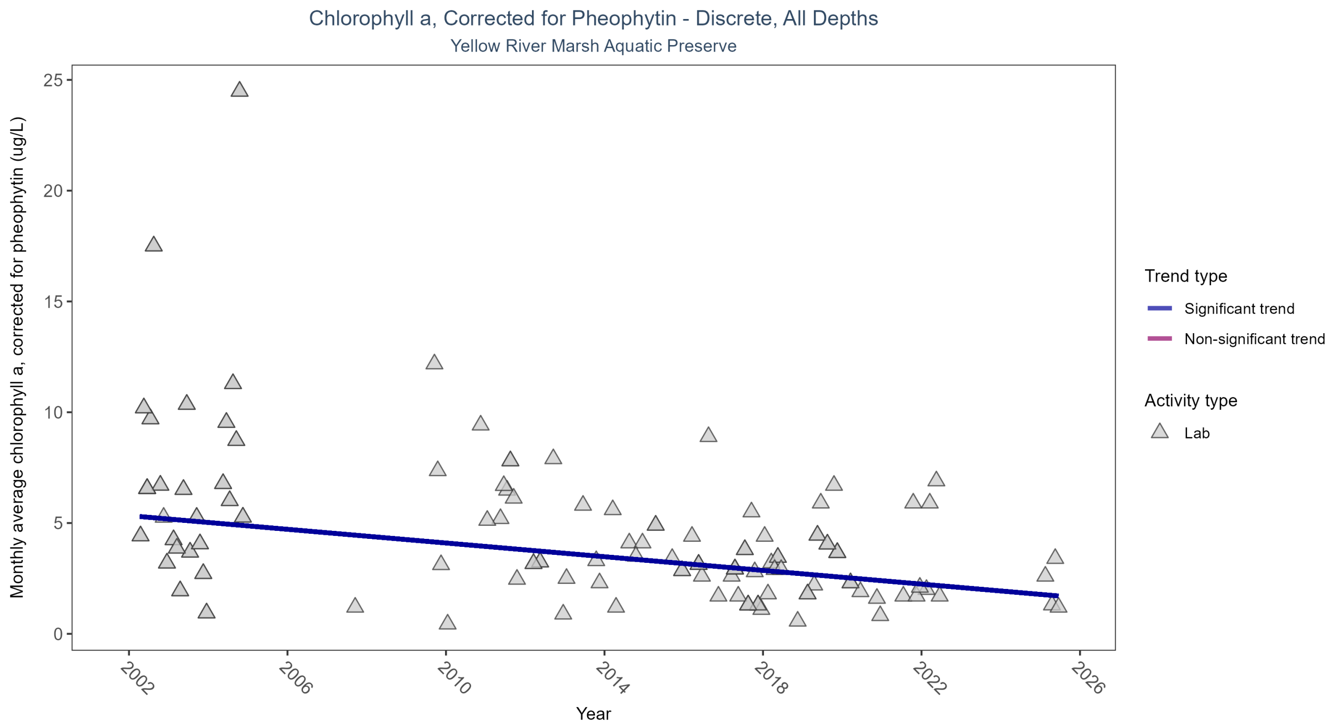

Figure 1: Scatter plot of monthly average levels of chlorophyll a, corrected for pheophytin, over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed chlorophyll a (triangles)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

Table 6: Seasonal Kendall-Tau Trend Analysis for Chlorophyll a, Corrected for Pheophytin

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Lab	Significantly decreasing trend	146	19	2002 - 2025	3.6069	-0.311	5.3353	-0.1546	0

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

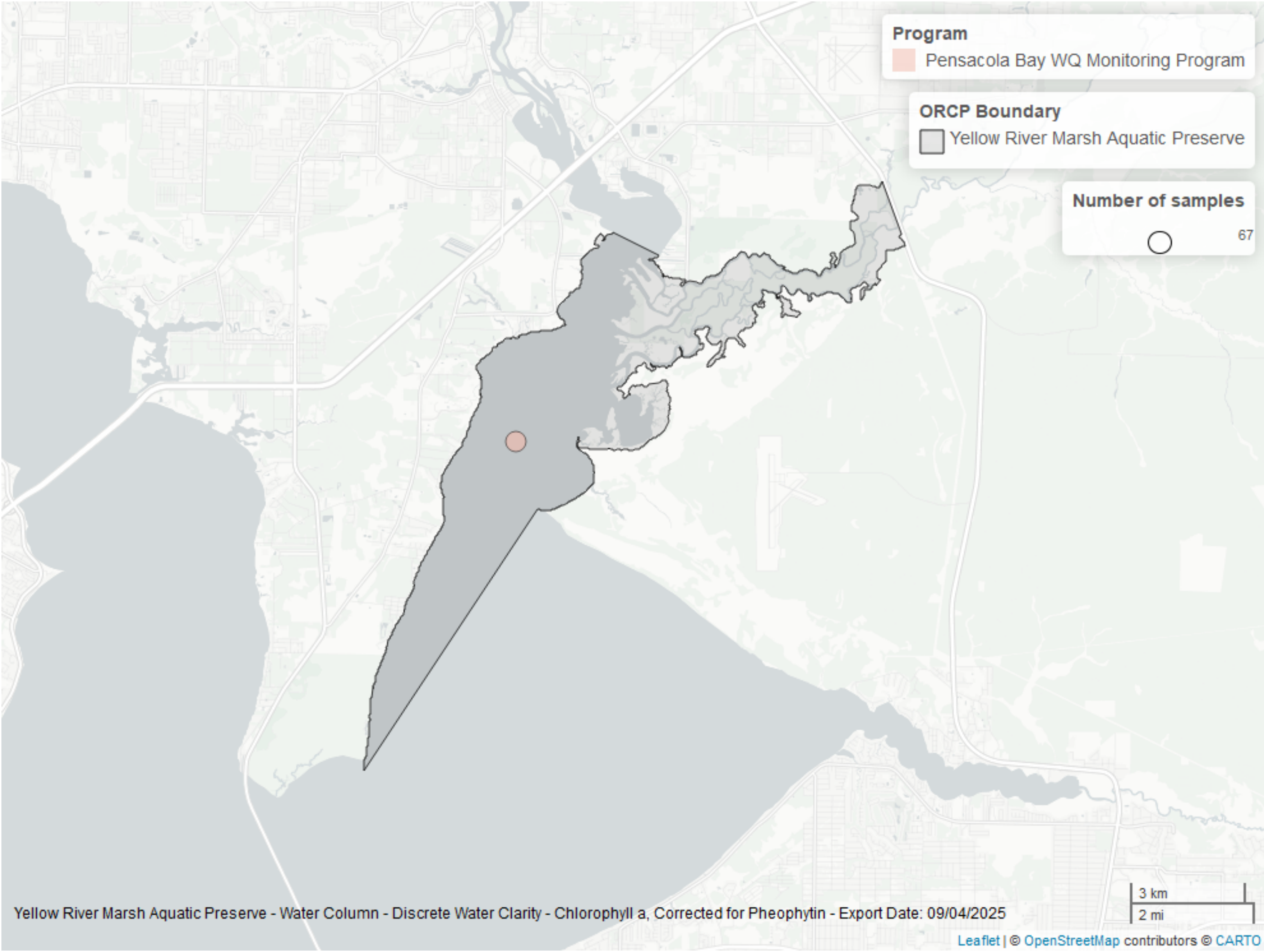

Figure 2: Map showing location of discrete water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

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

ProgramID	*N_Data*	*YearMin*	*YearMax*
505	67	2002	2012
5002	60	2007	2025
540	22	2016	2022

Program names:

505 - Pensacola Bay Water Quality Monitoring Program[1]
540 - Shellfish Harvest Area Classification Program[2]
5002 - Florida STORET / WIN[3]

Chlorophyll a, Uncorrected for Pheophytin - Discrete

Seasonal Kendall-Tau Trend Analysis

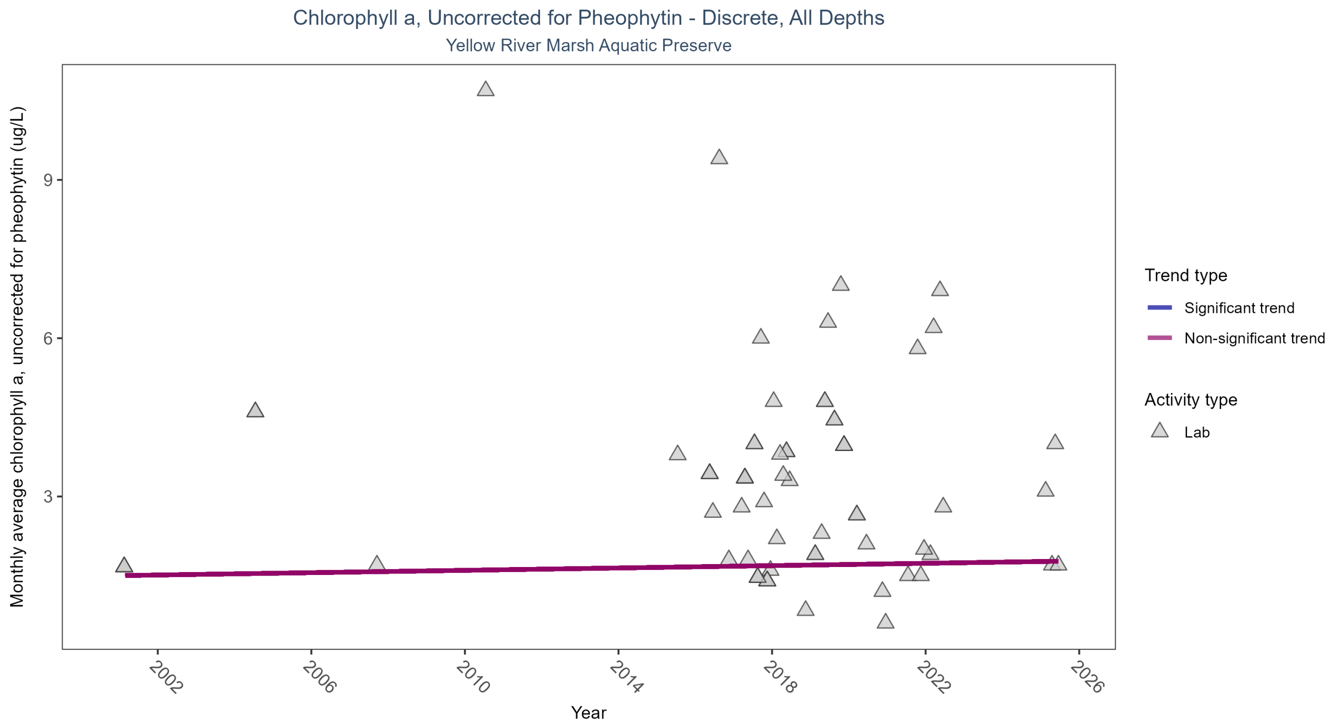

Figure 3: Scatter plot of monthly average levels of chlorophyll a, uncorrected for pheophytin, over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed chlorophyll a (triangles) 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	68	13	2001 - 2025	2.8	0.0504	1.501	0.0111	0.9342

Chlorophyll a, uncorrected for pheophytin, showed no detectable trend between 2001 and 2025.

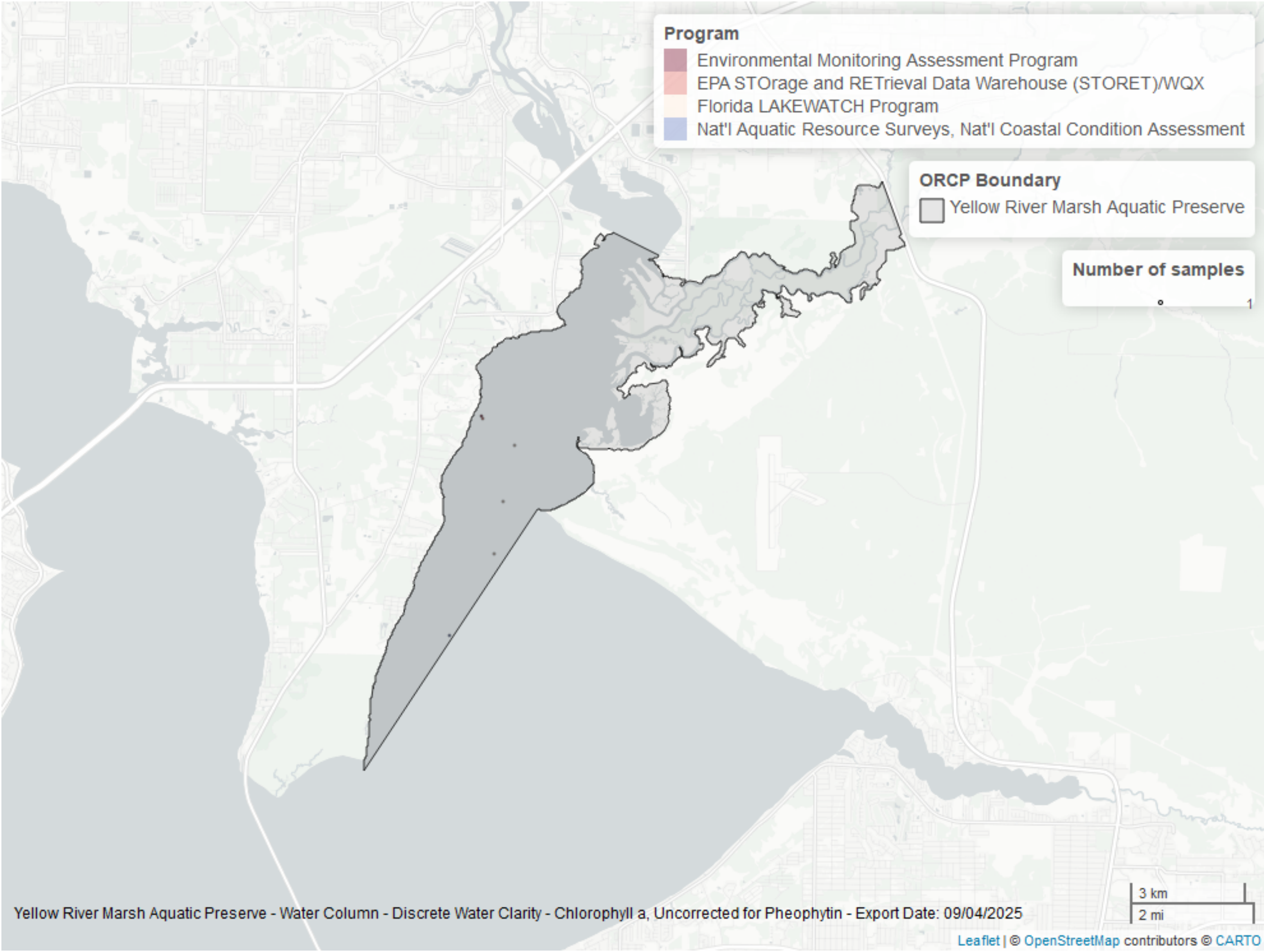

Figure 4: Map showing location of discrete water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

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

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	46	2007	2025
540	23	2016	2022
514	3	2001	2001
103	2	2004	2015
118	1	2010	2010
115	1	2004	2004

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[4]
115 - Environmental Monitoring Assessment Program[5]
118 - National Aquatic Resource Surveys, National Coastal Condition Assessment[6]
514 - Florida LAKEWATCH Program[7]
540 - Shellfish Harvest Area Classification Program[2]
5002 - Florida STORET / WIN[3]

Dissolved Oxygen - Discrete

Seasonal Kendall-Tau Trend Analysis

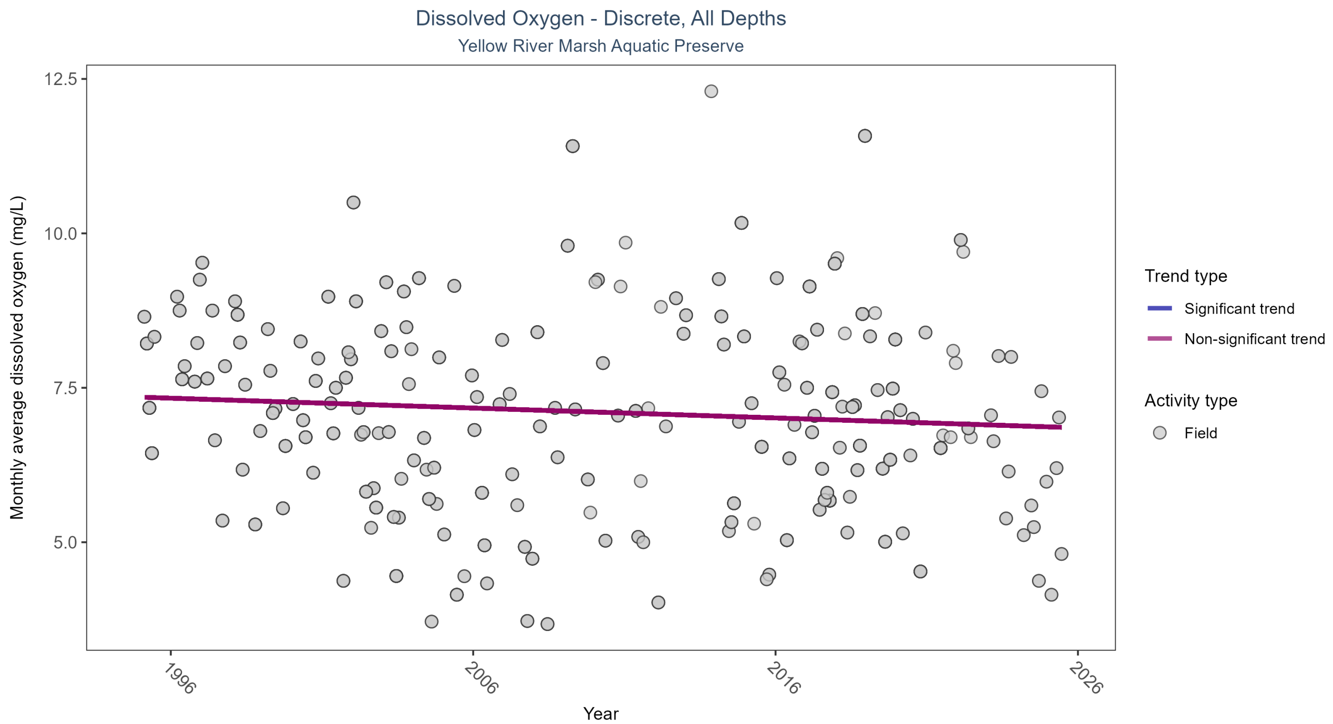

Figure 5: Scatter plot of monthly average dissolved oxygen over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only dissolved oxygen values measured in the field (circles) are included in the plot.

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	1119	31	1995 - 2025	7.2	-0.0482	7.348	-0.016	0.1393

Dissolved oxygen showed no detectable trend between 1995 and 2025.

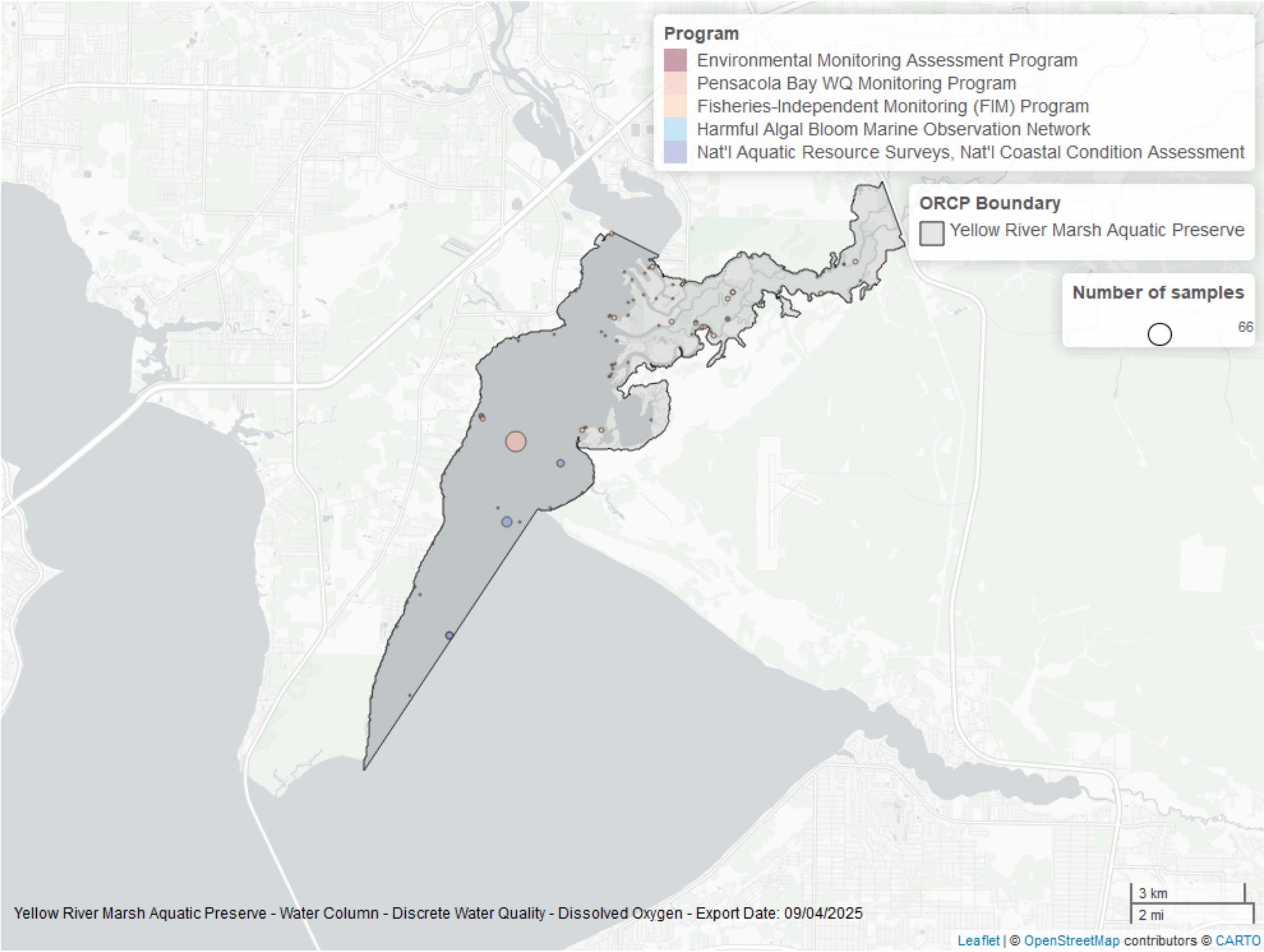

Figure 6: Map showing location of discrete water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 11: Programs contributing data for Dissolved Oxygen

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	817	1995	2025
69	168	2003	2019
505	66	2002	2012
118	41	2015	2021
540	21	2016	2022
103	9	2015	2015
95	4	2000	2017
115	3	2004	2004

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program[8]
95 - Harmful Algal Bloom Marine Observation Network[9]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[4]
115 - Environmental Monitoring Assessment Program[5]

118 - National Aquatic Resource Surveys, National Coastal Condition Assessment[6]
505 - Pensacola Bay Water Quality Monitoring Program[1]
540 - Shellfish Harvest Area Classification Program[2]
5002 - Florida STORET / WIN[3]

Dissolved Oxygen Saturation - Discrete

Seasonal Kendall-Tau Trend Analysis

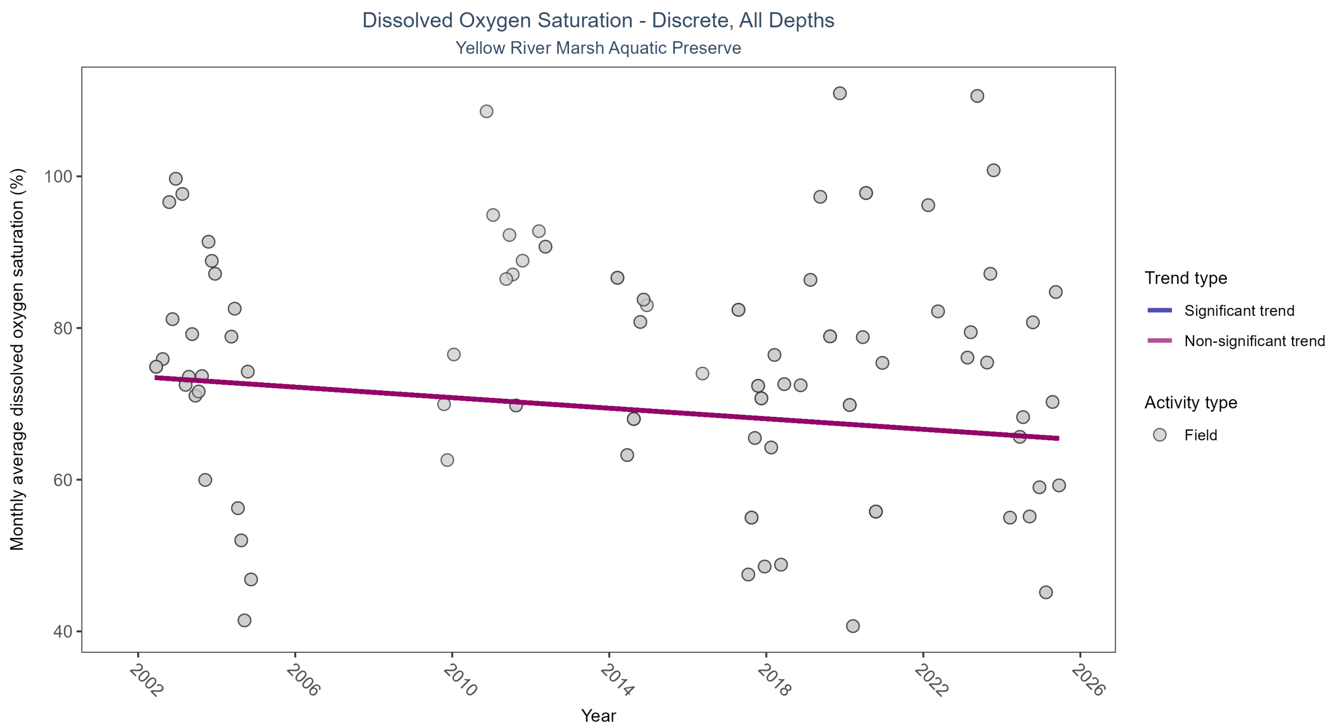

Figure 7: Scatter plot of monthly average dissolved oxygen saturation over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only dissolved oxygen saturation values measured in the field (circles) 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	183	17	2002 - 2025	75.6	-0.0935	73.6038	-0.3481	0.3327

Dissolved oxygen saturation showed no detectable trend between 2002 and 2025.

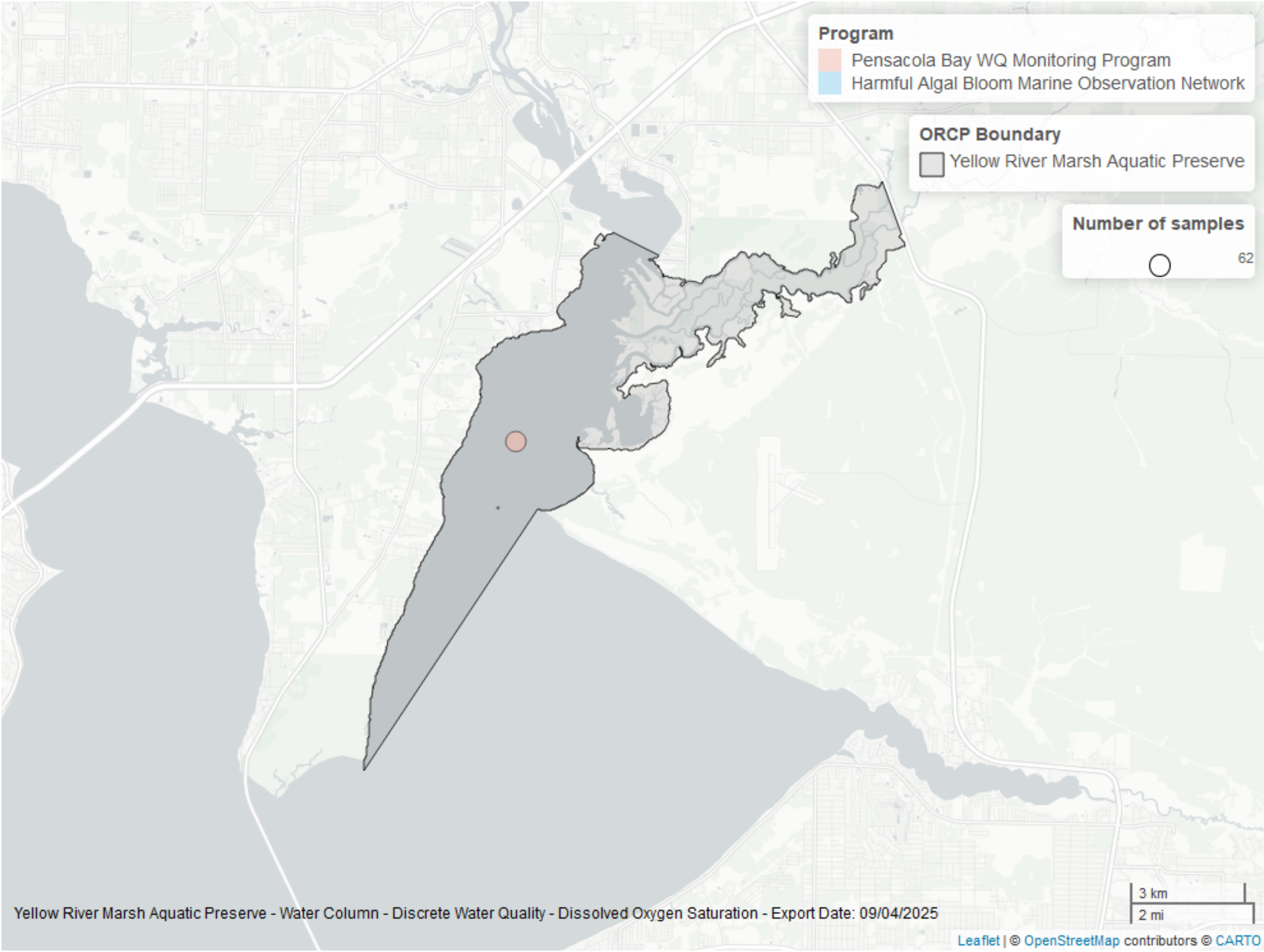

Figure 8: Map showing location of discrete water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 13: Programs contributing data for Dissolved Oxygen Saturation

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	124	2014	2025
505	62	2002	2012
95	1	2017	2017

Program names:

95 - Harmful Algal Bloom Marine Observation Network[9]
505 - Pensacola Bay Water Quality Monitoring Program[1]
5002 - Florida STORET / WIN[3]

pH - Discrete

Seasonal Kendall-Tau Trend Analysis

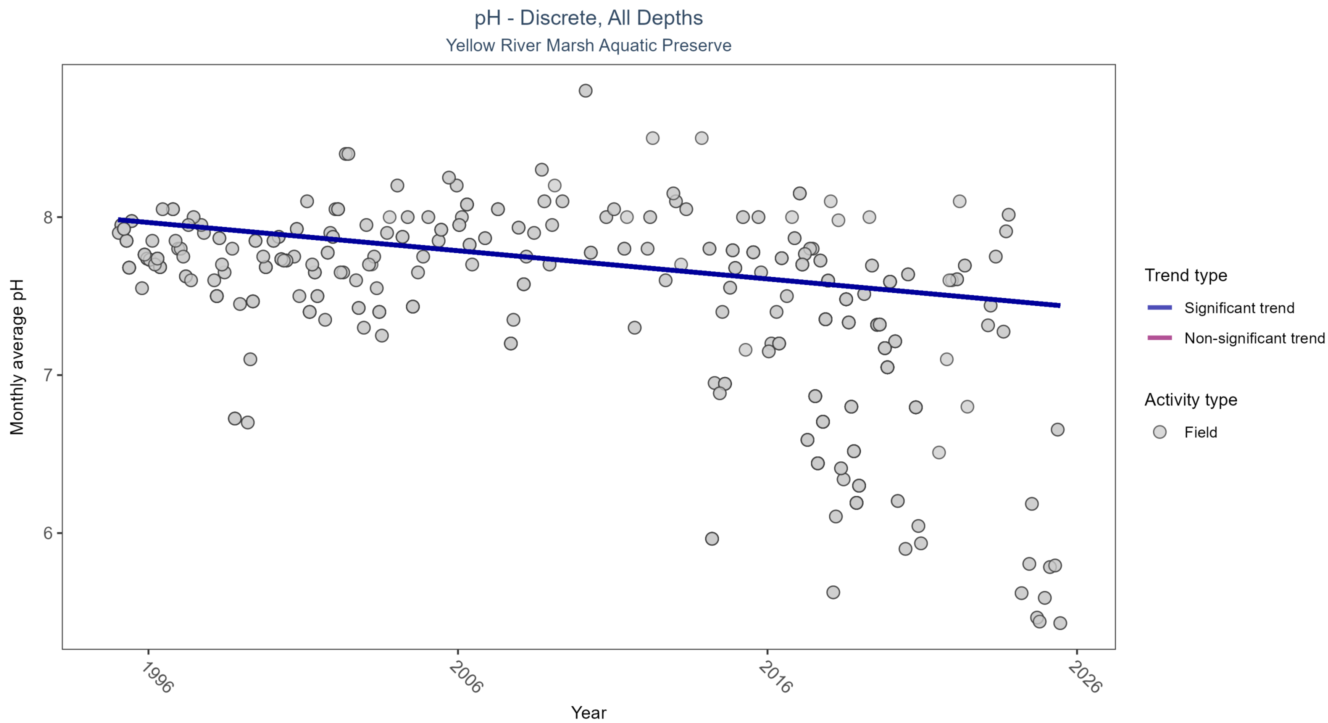

Figure 9: Scatter plot of monthly average pH over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only pH values measured in the field (circles) are included in the plot.

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	751	31	1995 - 2025	7.64	-0.2087	7.9838	-0.0179	0

Monthly average pH decreased by 0.02 pH units per year.

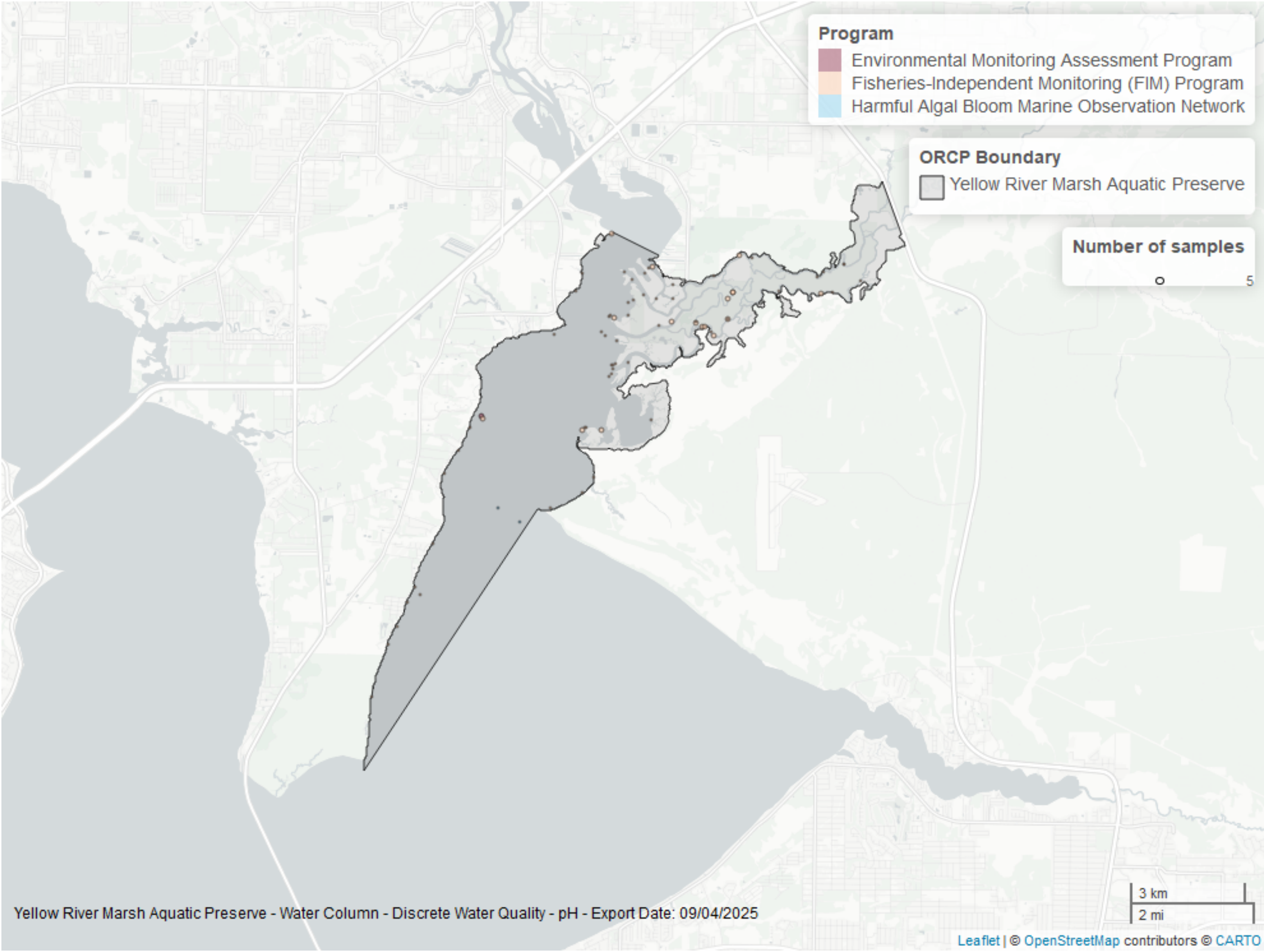

Figure 10: Map showing location of discrete water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 15: Programs contributing data for pH

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	566	1995	2025
69	160	2003	2019
540	21	2016	2022
103	8	2015	2015
95	3	2014	2017
115	3	2004	2004

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program[8]
95 - Harmful Algal Bloom Marine Observation Network[9]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[4]
115 - Environmental Monitoring Assessment Program[5]
540 - Shellfish Harvest Area Classification Program[2]
5002 - Florida STORET / WIN[3]

Salinity - Discrete

Seasonal Kendall-Tau Trend Analysis

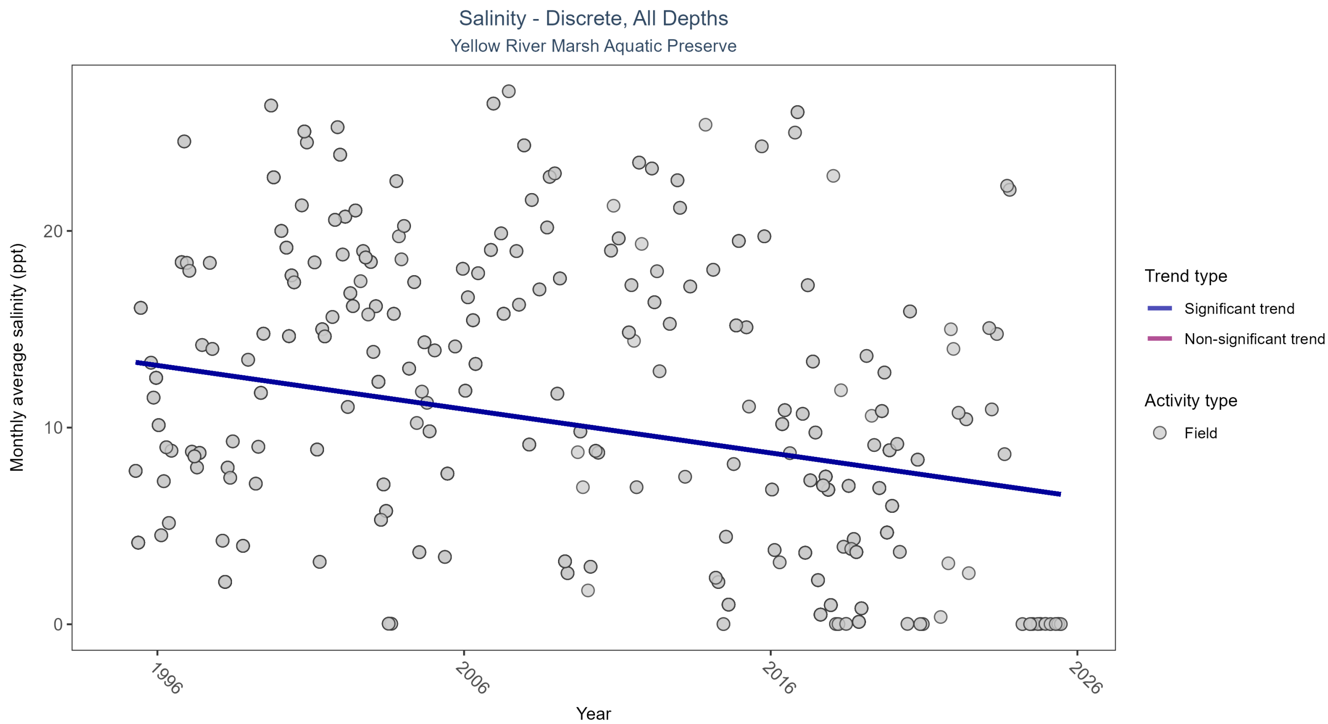

Figure 11: Scatter plot of monthly average salinity over time. If the time series included ten or more years of discrete observations, significant (blue) or non-significant (magenta) trend lines are also shown. Discrete salinity values derived from grab samples analyzed in the field (circles) or the 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	1252	31	1995 - 2025	11	-0.151	13.384	-0.2225	0.001

Monthly average salinity decreased by 0.22 ppt per year.

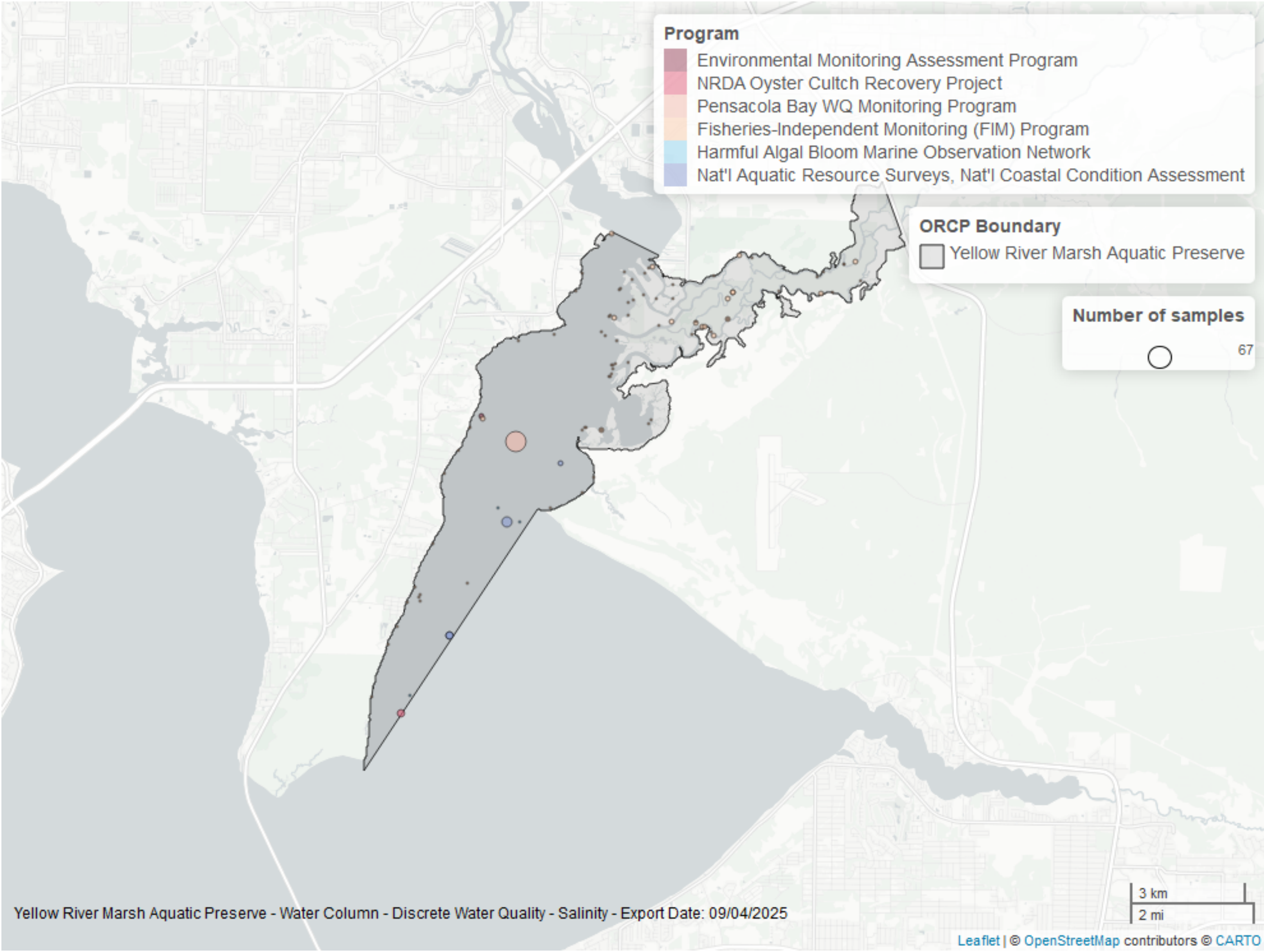

Figure 12: Map showing location of discrete water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 17: Programs contributing data for Salinity

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	936	1995	2025
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

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program[8]
95 - Harmful Algal Bloom Marine Observation Network[9]
115 - Environmental Monitoring Assessment Program[5]
118 - National Aquatic Resource Surveys, National Coastal Condition Assessment[6]

505 - Pensacola Bay Water Quality Monitoring Program[1]
540 - Shellfish Harvest Area Classification Program[2]
4044 - NRDA Oyster Cultch Recovery Project[10]
5002 - Florida STORET / WIN[3]

Secchi Depth - Discrete

Seasonal Kendall-Tau Trend Analysis

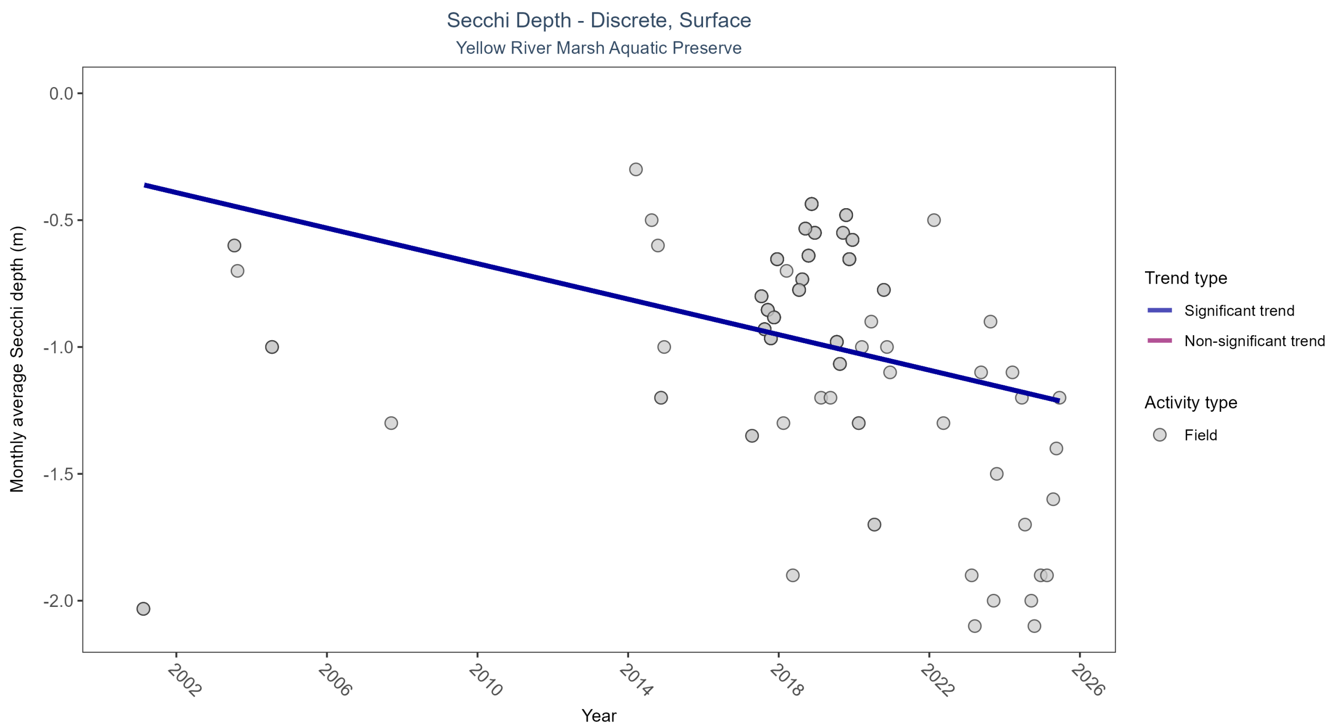

Figure 13: Scatter plot of monthly average Secchi depth over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Secchi depth is only measured in the field (circles).

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	242	14	2001 - 2025	-0.8	-0.3241	-0.3563	-0.035	0.0081

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

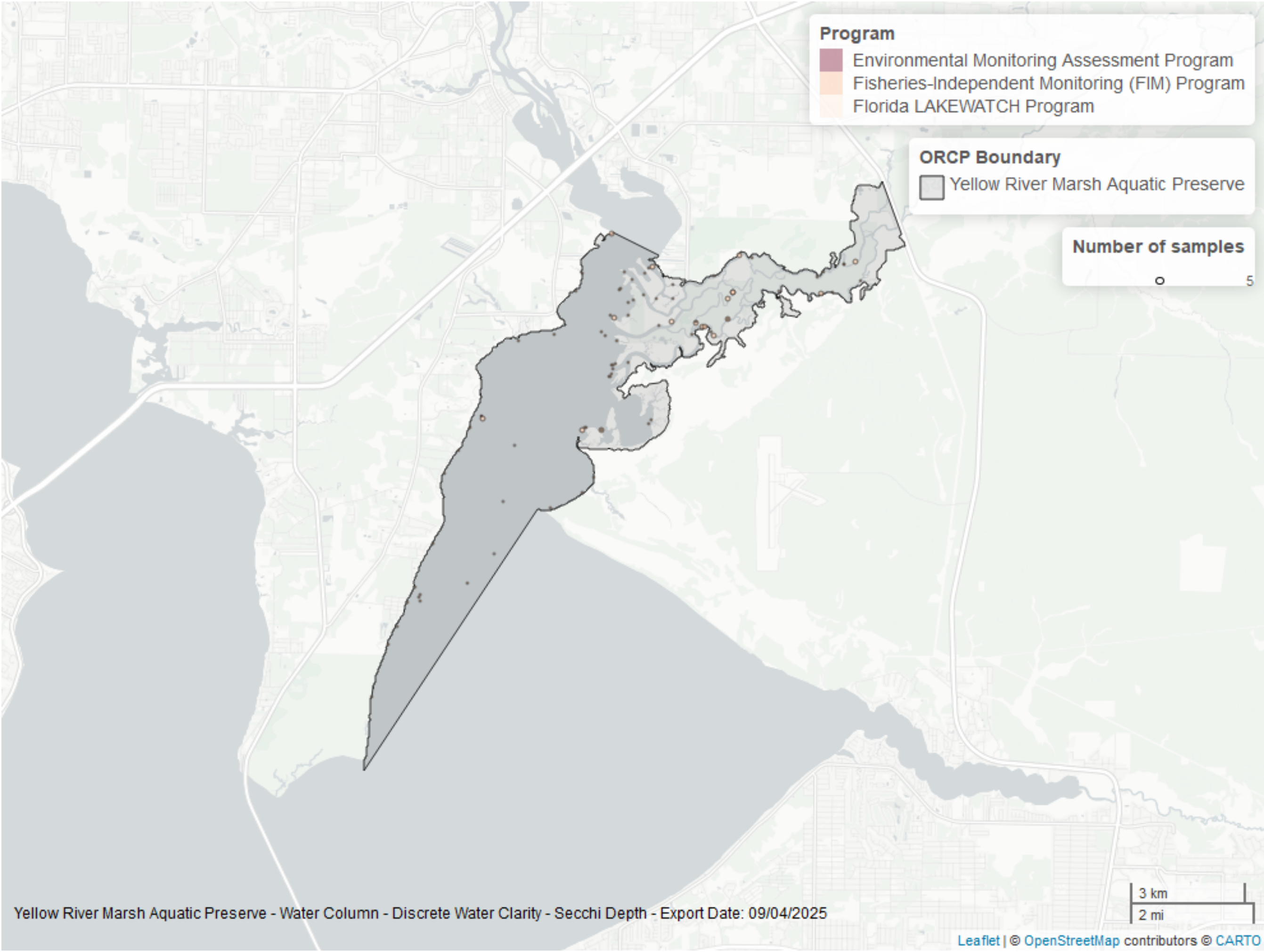

Figure 14: Map showing location of discrete water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 19: Programs contributing data for Secchi Depth

ProgramID	*N_Data*	*YearMin*	*YearMax*
69	180	2003	2019
5002	57	2007	2025
514	3	2001	2001
103	1	2015	2015
115	1	2004	2004

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program[8]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[4]
115 - Environmental Monitoring Assessment Program[5]
514 - Florida LAKEWATCH Program[7]
5002 - Florida STORET / WIN[3]

Total Nitrogen - Discrete

Total Nitrogen Calculation:

The logic for calculated Total Nitrogen was provided by Kevin O'Donnell and colleagues at FDEP (with the help of Jay Silvanima, Watershed Monitoring Section). The following logic is used, in this order, based on the availability of specific nitrogen components.

1) TN = TKN + NO3O2;
2) TN = TKN + NO3 + NO2;
3) TN = ORGN + NH4 + NO3O2;
4) TN = ORGN + NH4 + NO2 + NO3;
5) TN = TKN + NO3;
6) TN = ORGN + NH4 + NO3;

Additional Information:

- Rules for use of sample fraction:
  - Florida Department of Environmental Protection (FDEP) report that if both "Total" and "Dissolved" components are reported, only "Total" is used. If the total is not reported, then the dissolved components are used as a best available replacement.
  - Total nitrogen calculations are done using nitrogen components with the same sample fraction, nitrogen components with mixed total/dissolved sample fractions are not used. In other words, total nitrogen can be calculated when TKN and NO3O2 are both total sample fractions, or when both are dissolved sample fractions. *Future calculations of total nitrogen values may be based on components with mixed sample fractions.*
- Values inserted into data:
  - ParameterName = "Total Nitrogen"
  - SEACAR_QAQCFlagCode = "1Q"
  - SEACAR_QAQC_Description = "SEACAR Calculated"

Seasonal Kendall-Tau Trend Analysis

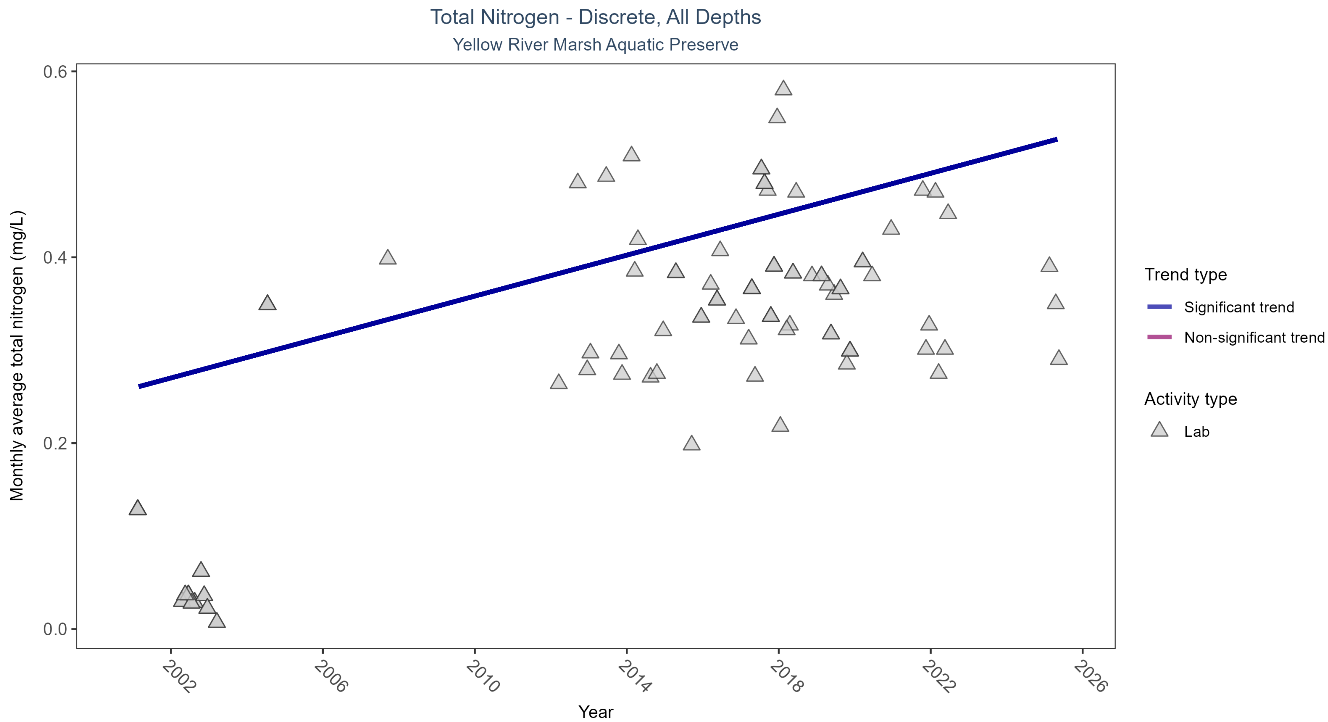

Figure 15: Scatter plot of monthly average total nitrogen over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only nitrogen values obtained from laboratory analyses (triangles) are included in the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

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

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Lab	Significantly increasing trend	109	17	2001 - 2025	0.322	0.2395	0.2591	0.011	0.0281

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

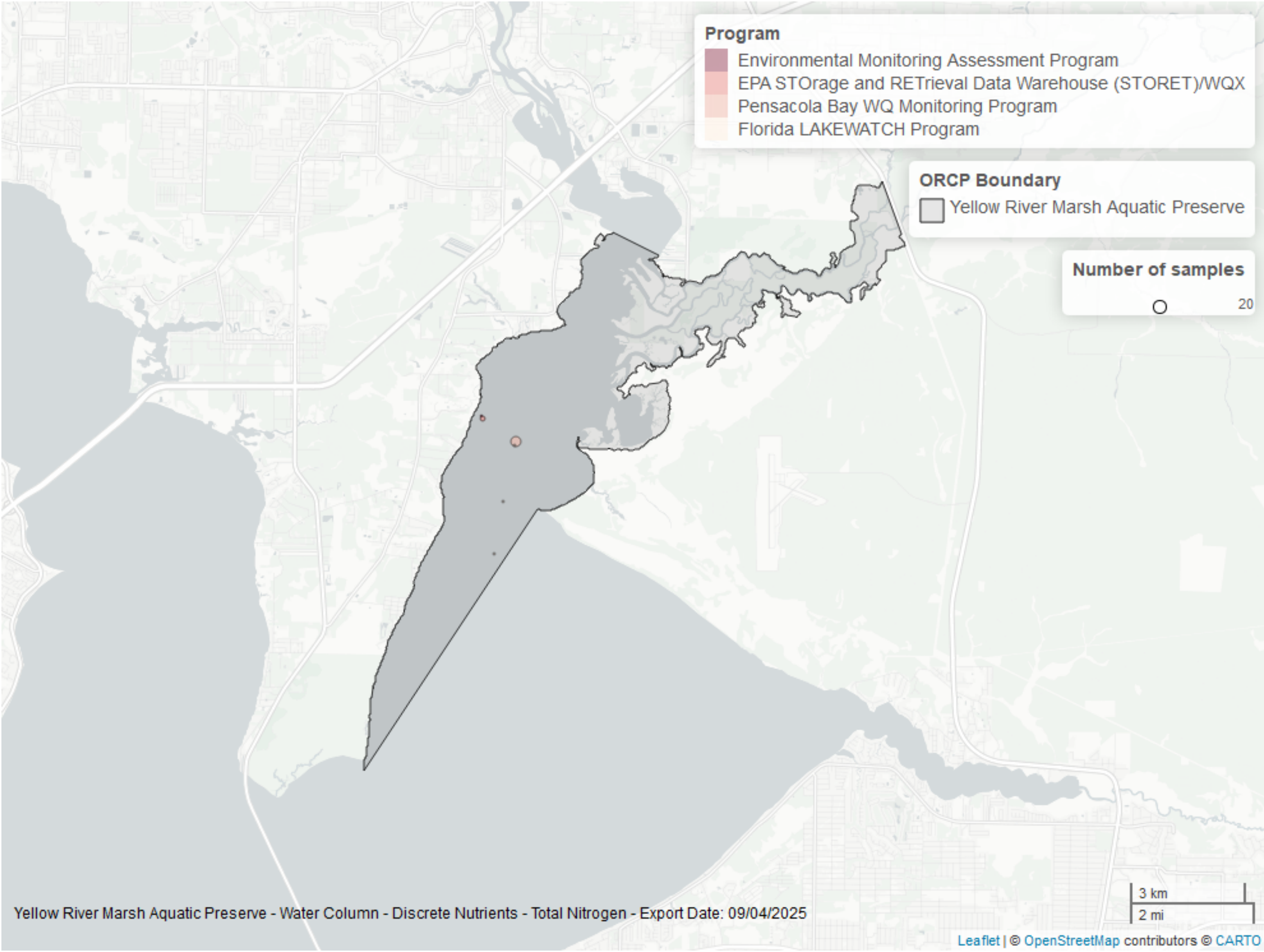

Figure 16: Map showing location of discrete water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 21: Programs contributing data for Total Nitrogen

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	62	2001	2025
505	20	2002	2003
540	19	2017	2022
103	4	2004	2004
514	3	2001	2001
115	1	2004	2004

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[4]
115 - Environmental Monitoring Assessment Program[5]
505 - Pensacola Bay Water Quality Monitoring Program[1]
514 - Florida LAKEWATCH Program[7]
540 - Shellfish Harvest Area Classification Program[2]
5002 - Florida STORET / WIN[3]

Total Phosphorus - Discrete

Seasonal Kendall-Tau Trend Analysis

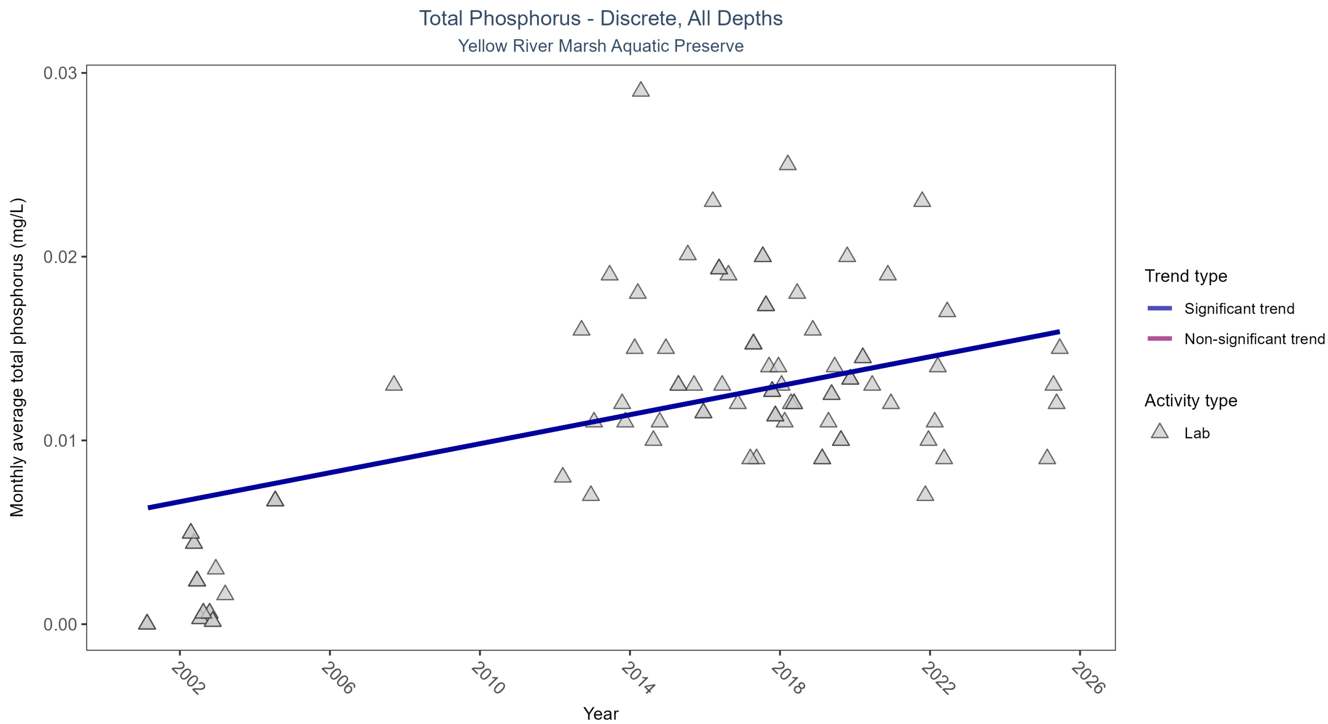

Figure 17: Scatter plot of monthly average total phosphorus over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only phosphorus values obtained from laboratory analyses (triangles) are included 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	107	17	2001 - 2025	0.012	0.2714	0.0063	0.0004	0.0186

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

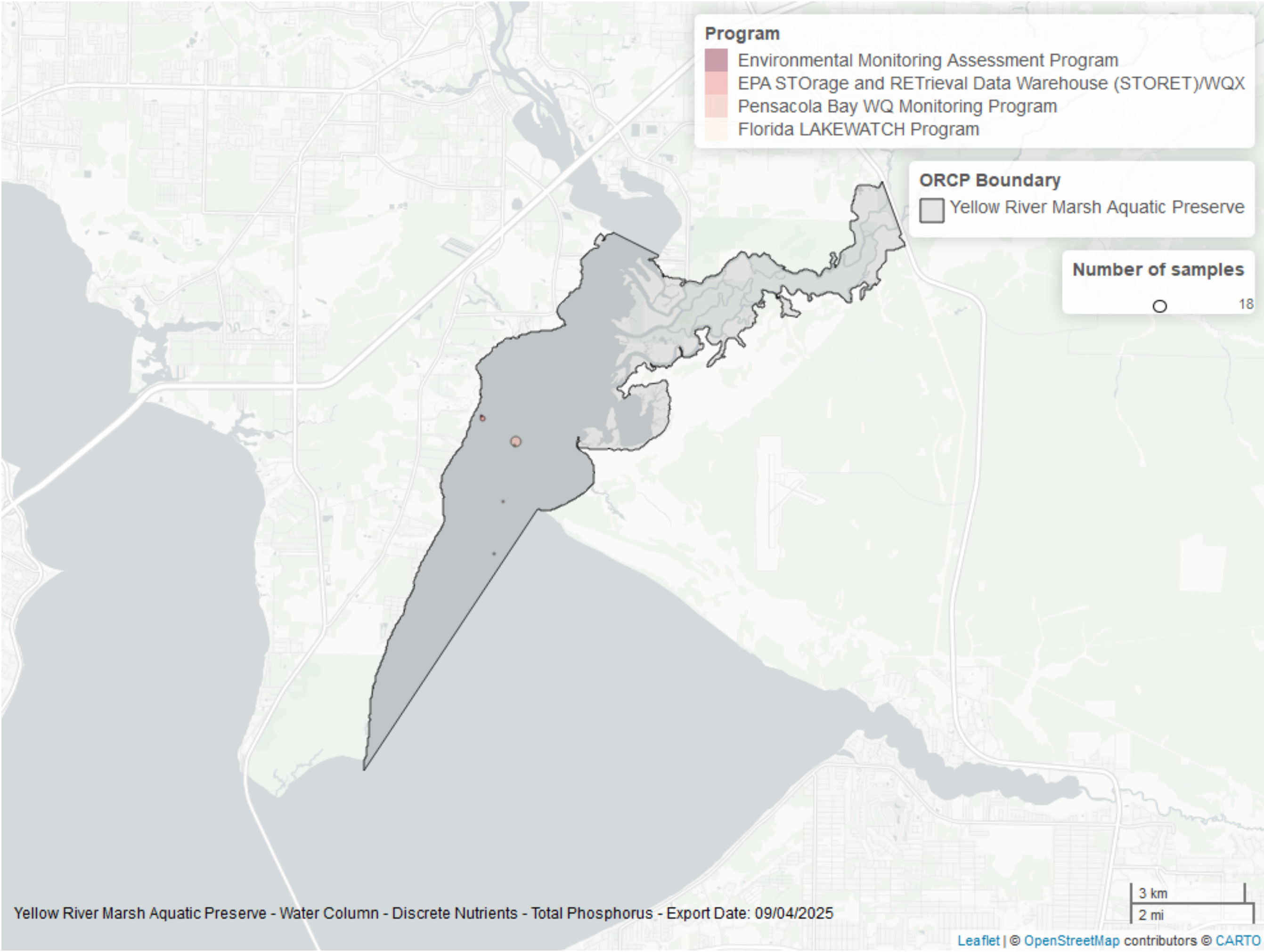

Figure 18: Map showing location of discrete water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 23: Programs contributing data for Total Phosphorus

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	61	2007	2025
540	22	2016	2022
505	18	2002	2003
103	4	2004	2015
514	3	2001	2001
115	1	2004	2004

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[4]
115 - Environmental Monitoring Assessment Program[5]
505 - Pensacola Bay Water Quality Monitoring Program[1]
514 - Florida LAKEWATCH Program[7]
540 - Shellfish Harvest Area Classification Program[2]
5002 - Florida STORET / WIN[3]

Total Suspended Solids - Discrete

Seasonal Kendall-Tau Trend Analysis

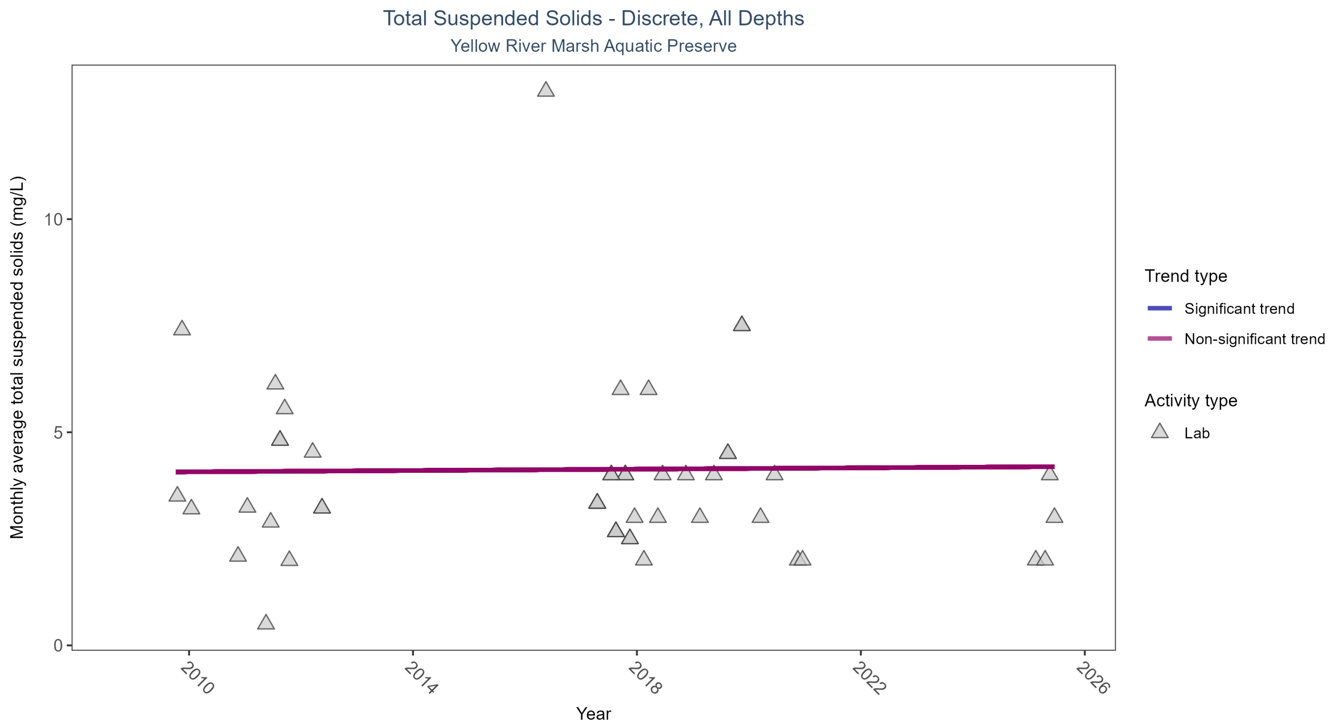

Figure 19: Scatter plot of monthly average total suspended solids (TSS) over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only TSS values obtained from laboratory analyses (triangles) are included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

Table 24: Seasonal Kendall-Tau Trend Analysis for Total Suspended Solids

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Lab	No significant trend	49	10	2009 - 2025	3.24	-0.0088	4.0637	0.0079	0.7404

Total suspended solids showed no detectable trend between 2009 and 2025.

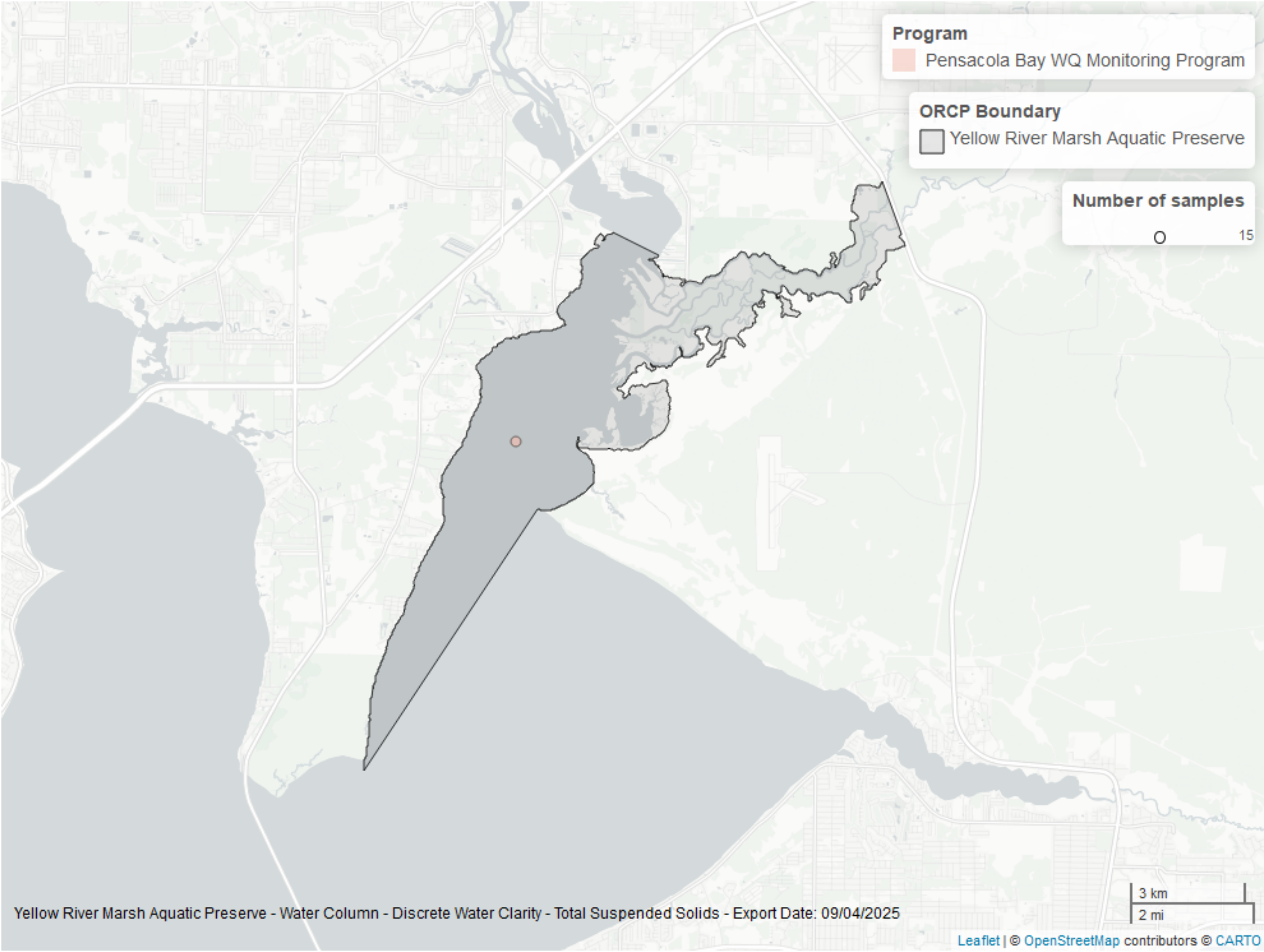

Figure 20: Map showing location of discrete water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 25: Programs contributing data for Total Suspended Solids

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	38	2016	2025
505	15	2009	2012

Program names:

505 - Pensacola Bay Water Quality Monitoring Program[1]
5002 - Florida STORET / WIN[3]

Turbidity - Discrete

Seasonal Kendall-Tau Trend Analysis

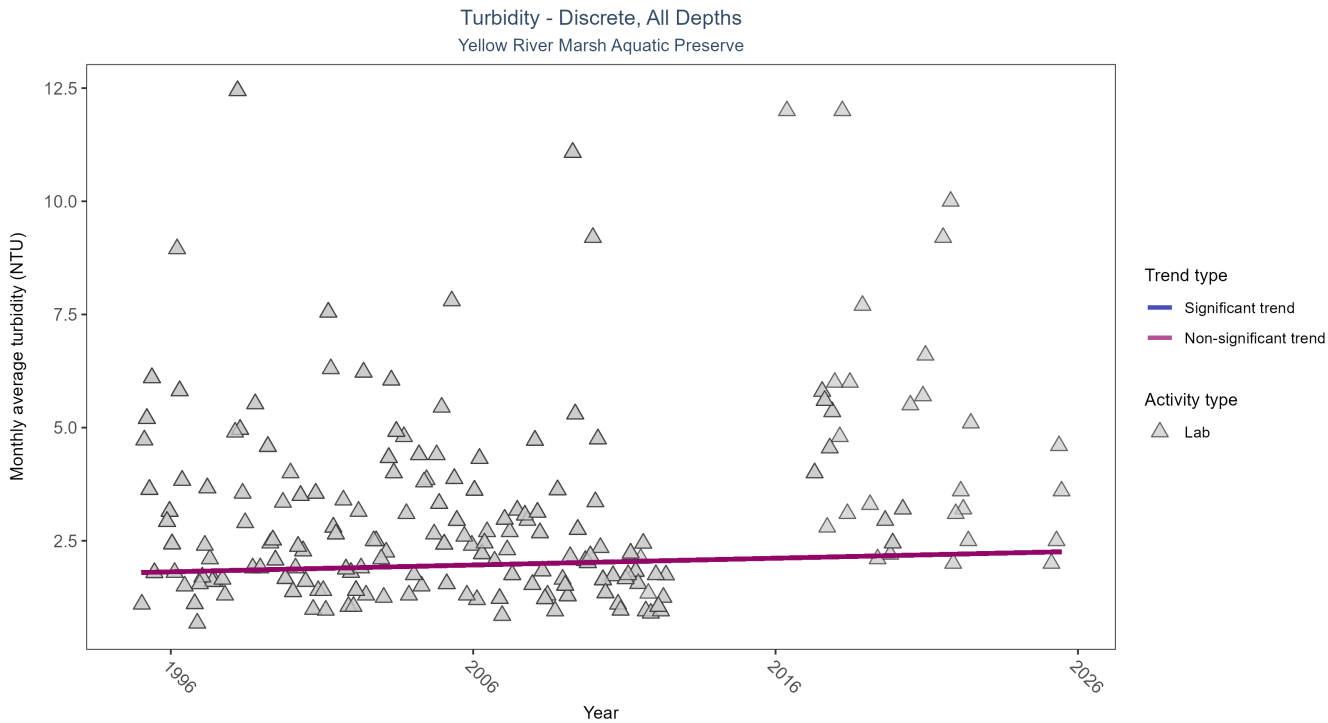

Figure 21: Scatter plot of monthly average turbidity over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only turbidity values measured in the laboratory (triangles) are included in the plot.

Table 26: Seasonal Kendall-Tau Trend Analysis for Turbidity

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Lab	No significant trend	593	26	1995 - 2025	2.5	0.0844	1.7989	0.015	0.3945

Turbidity showed no detectable trend between 1995 and 2025.

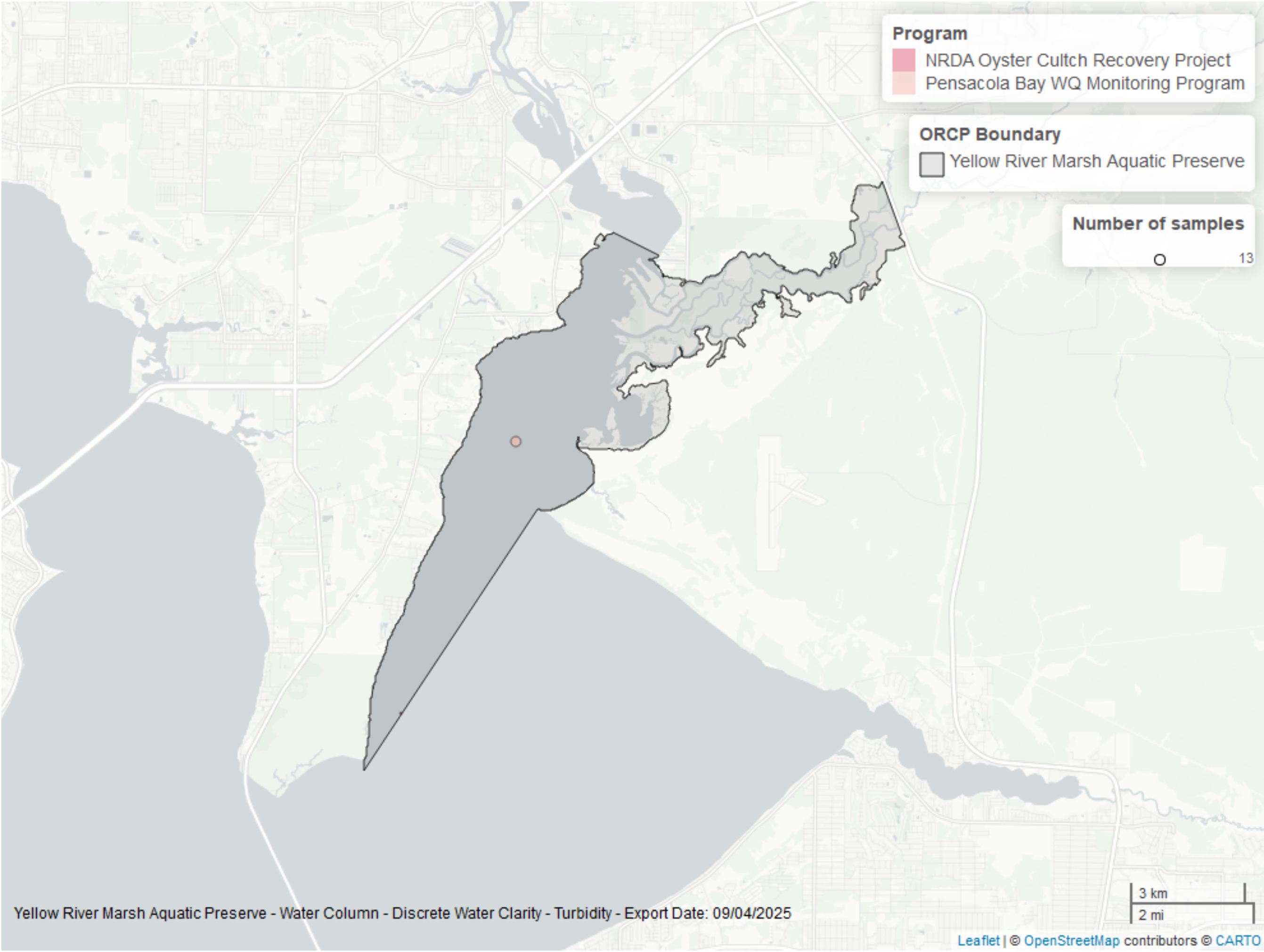

Figure 22: Map showing location of discrete water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 27: Programs contributing data for Turbidity

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	573	1995	2025
505	13	2009	2012
540	12	2019	2022
4044	2	2023	2023

Program names:

505 - Pensacola Bay Water Quality Monitoring Program[1]
540 - Shellfish Harvest Area Classification Program[2]
4044 - NRDA Oyster Cultch Recovery Project[10]
5002 - Florida STORET / WIN[3]

Water Temperature - Discrete

Seasonal Kendall-Tau Trend Analysis

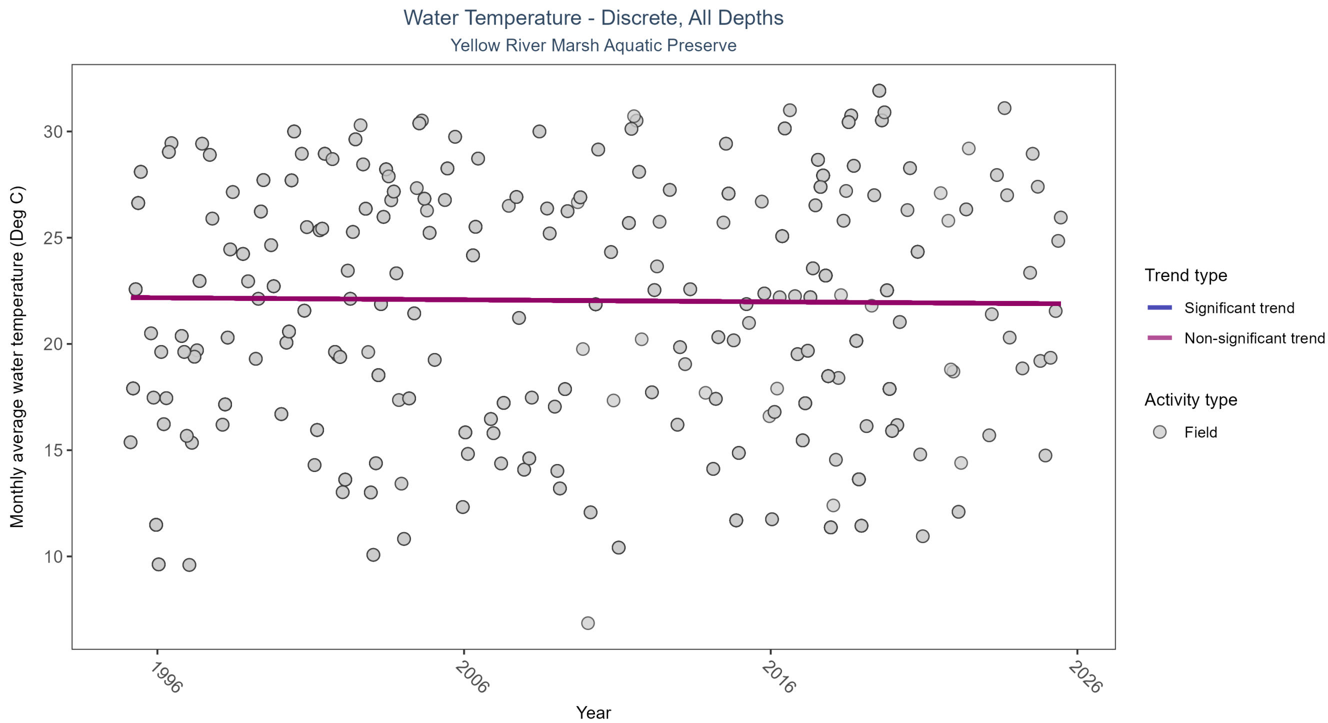

Figure 23: Scatter plot of monthly average water temperature over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only water temperature measurements taken in the field (circles) are included in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

Table 28: Seasonal Kendall-Tau Trend Analysis for Water Temperature

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Field	No significant trend	1245	31	1995 - 2025	22	-0.0128	22.1831	-0.0096	0.6147

Water temperature showed no detectable trend between 1995 and 2025.

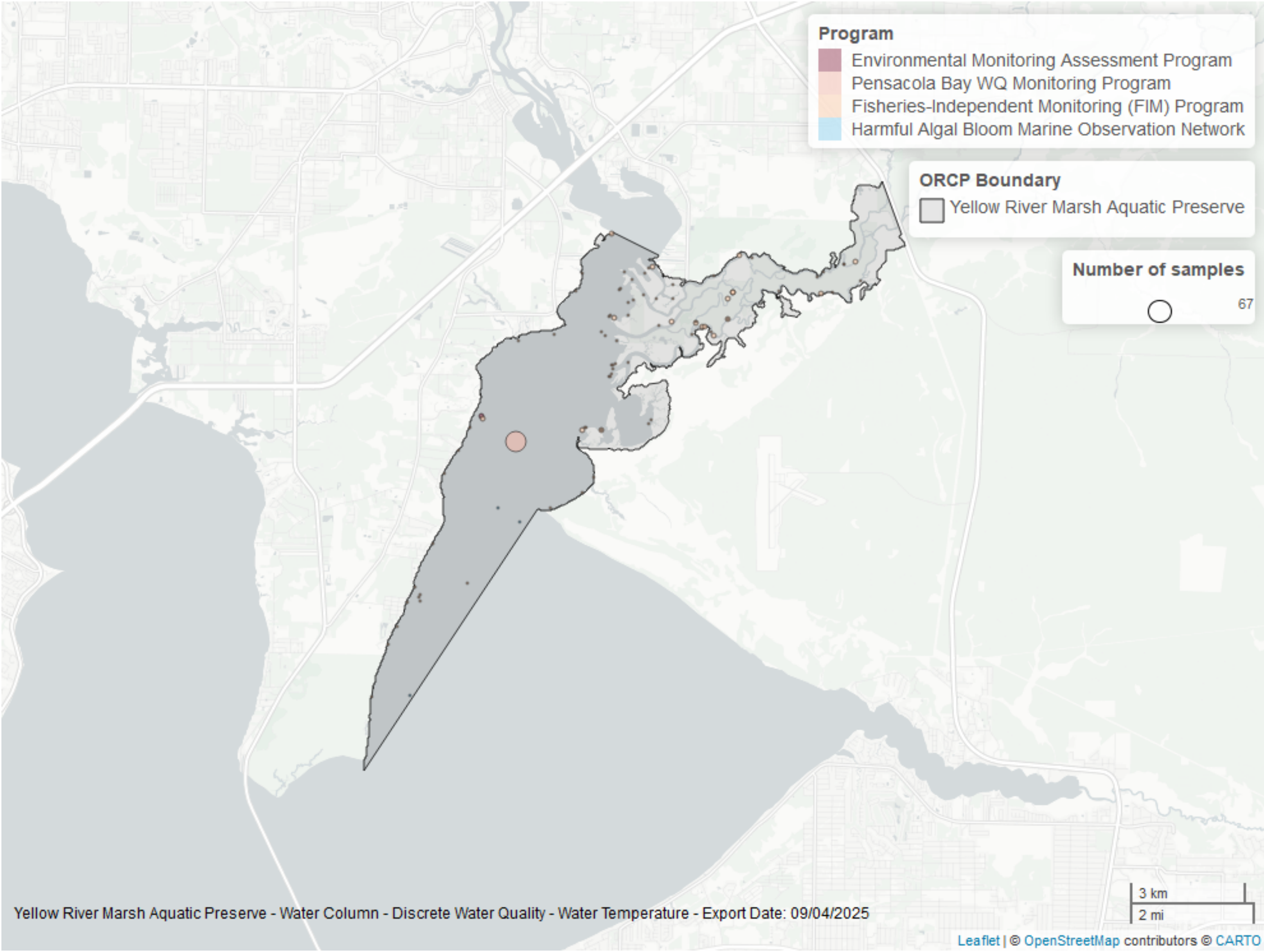

Figure 24: Map showing location of discrete water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 29: Programs contributing data for Water Temperature

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	968	1995	2025
69	182	2003	2019
505	67	2002	2012
540	21	2016	2022
95	4	2000	2017
115	3	2004	2004

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program[8]
95 - Harmful Algal Bloom Marine Observation Network[9]
115 - Environmental Monitoring Assessment Program[5]
505 - Pensacola Bay Water Quality Monitoring Program[1]
540 - Shellfish Harvest Area Classification Program[2]
5002 - Florida STORET / WIN[3]

Water Quality - Continuous

The following files were used in the continuous analysis:

- *Combined_WQ_WC_NUT_cont_Dissolved_Oxygen_NW-2025-Sep-19.txt*
- *Combined_WQ_WC_NUT_cont_Dissolved_Oxygen_Saturation_NW-2025-Sep-19.txt*
- *Combined_WQ_WC_NUT_cont_pH_NW-2025-Sep-19.txt*
- *Combined_WQ_WC_NUT_cont_Salinity_NW-2025-Sep-19.txt*
- *Combined_WQ_WC_NUT_cont_Turbidity_NW-2025-Sep-19.txt*
- *Combined_WQ_WC_NUT_cont_Water_Temperature_NW-2025-Sep-19.txt*

Continuous monitoring locations in Yellow River Marsh Aquatic Preserve

Table 30: Station overview for Continuous parameters by Program

ProgramID	*ProgramLocationID*	*Years of Data*	*Use in Analysis*	*Parameters*
467	YRMAP1	11	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 Monitoring[11]
505 - Pensacola Bay Water Quality Monitoring Program[1]

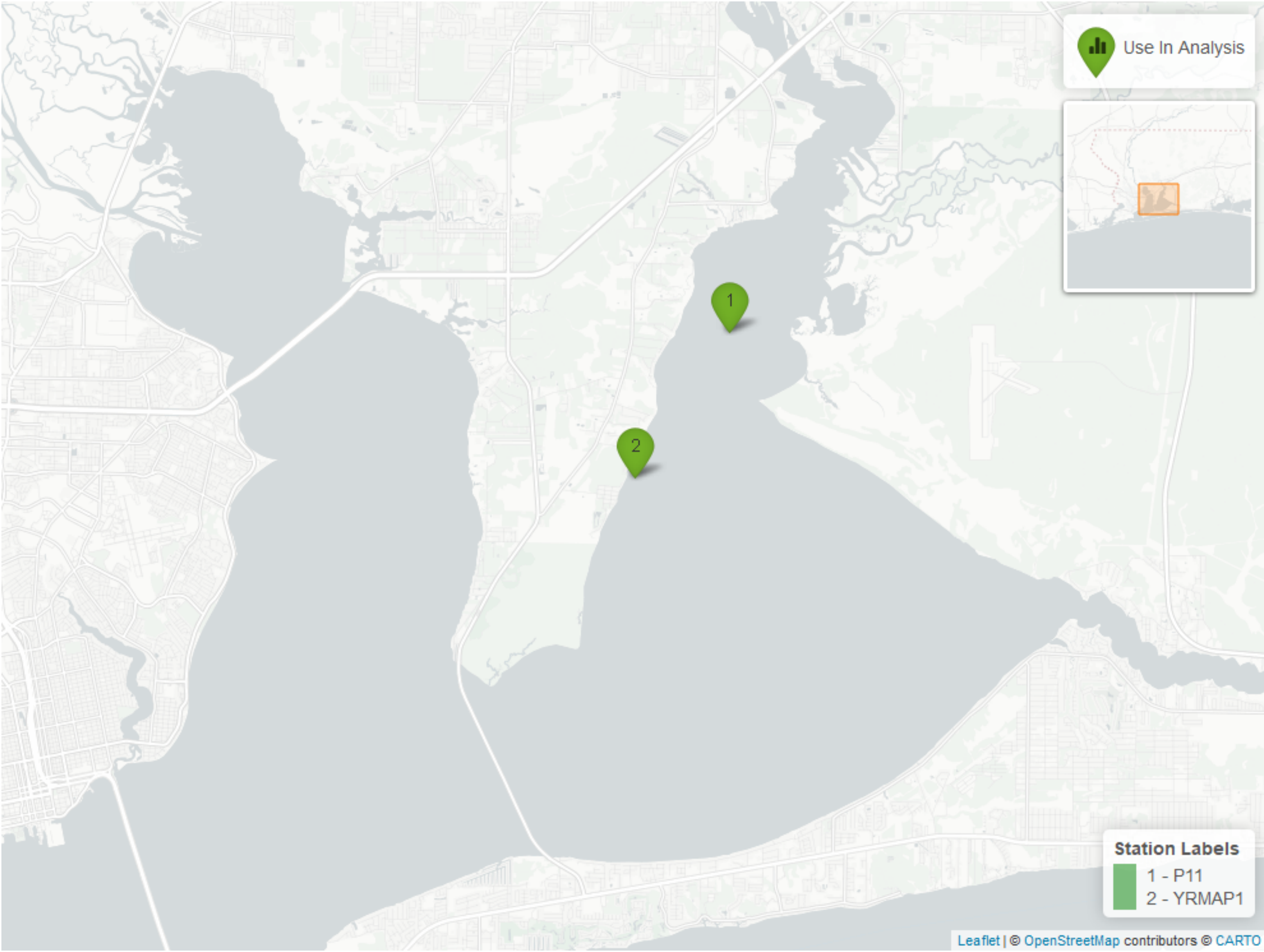

Figure 25: Map showing continuous water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. Sites marked as *Use In Analysis* (green) are featured in this report.

Dissolved Oxygen - Continuous

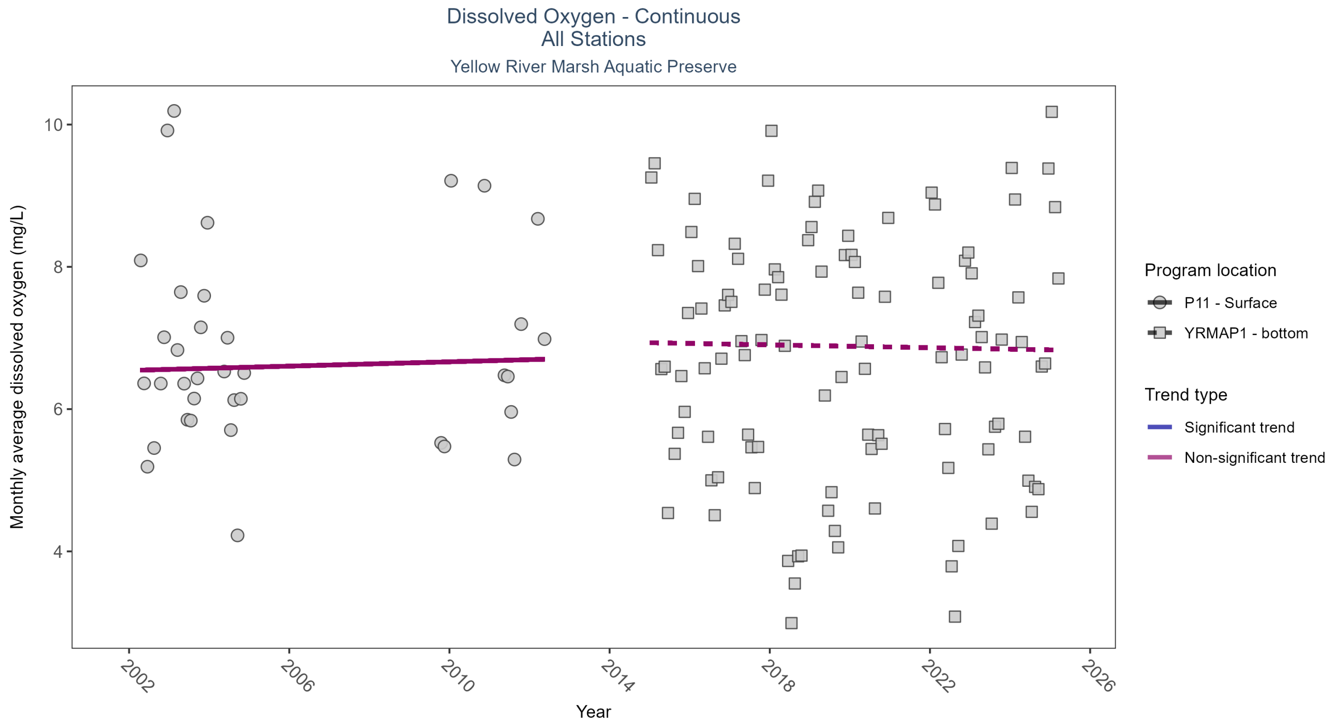

Figure 26: Scatter plot of monthly average dissolved oxygen over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 31: 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	267617	10	2015 - 2025	7.00	-0.04	6.93	-0.01	0.49
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.

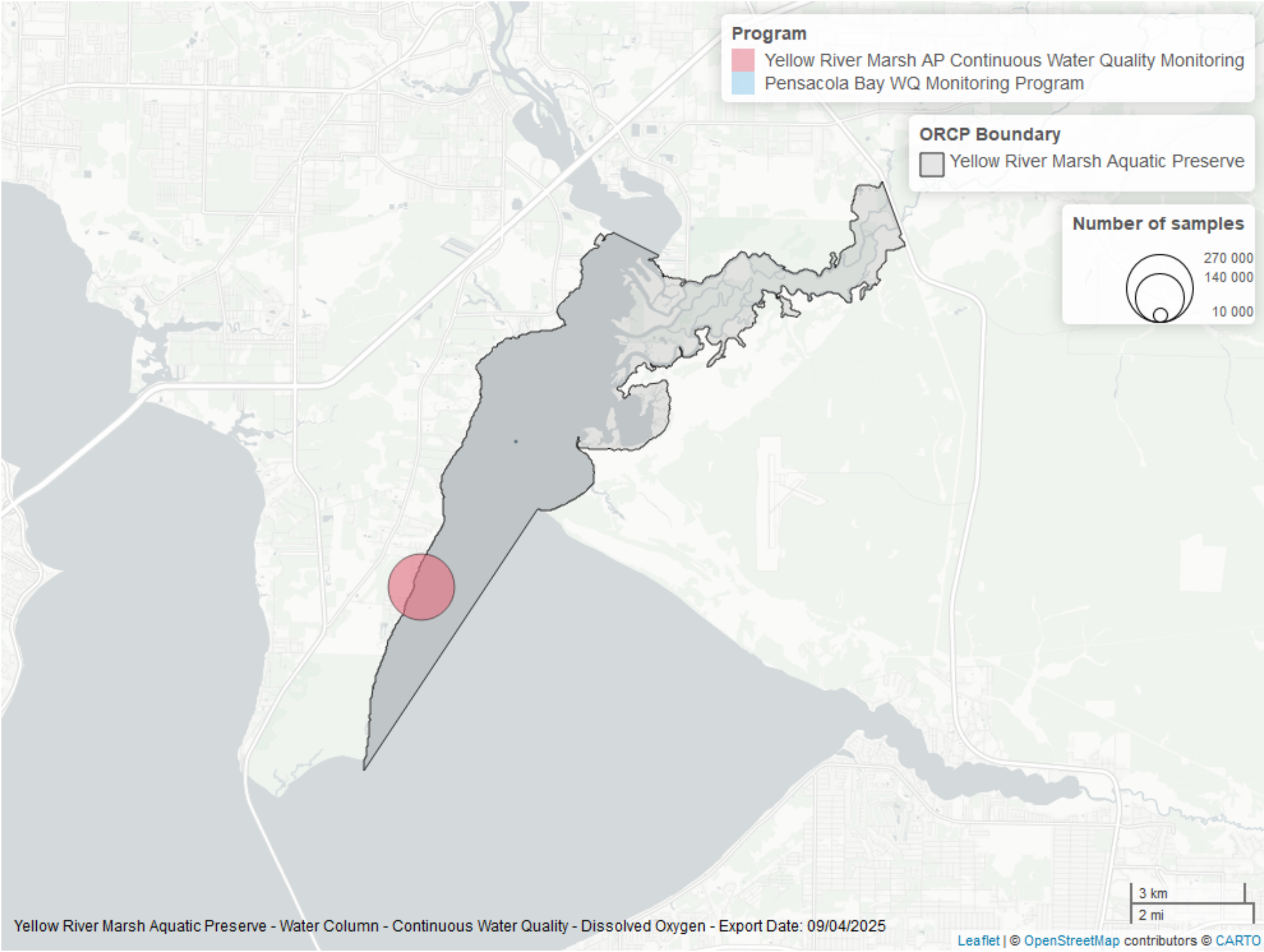

Figure 27: Map showing location of dissolved oxygen continuous water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Dissolved Oxygen Saturation - Continuous

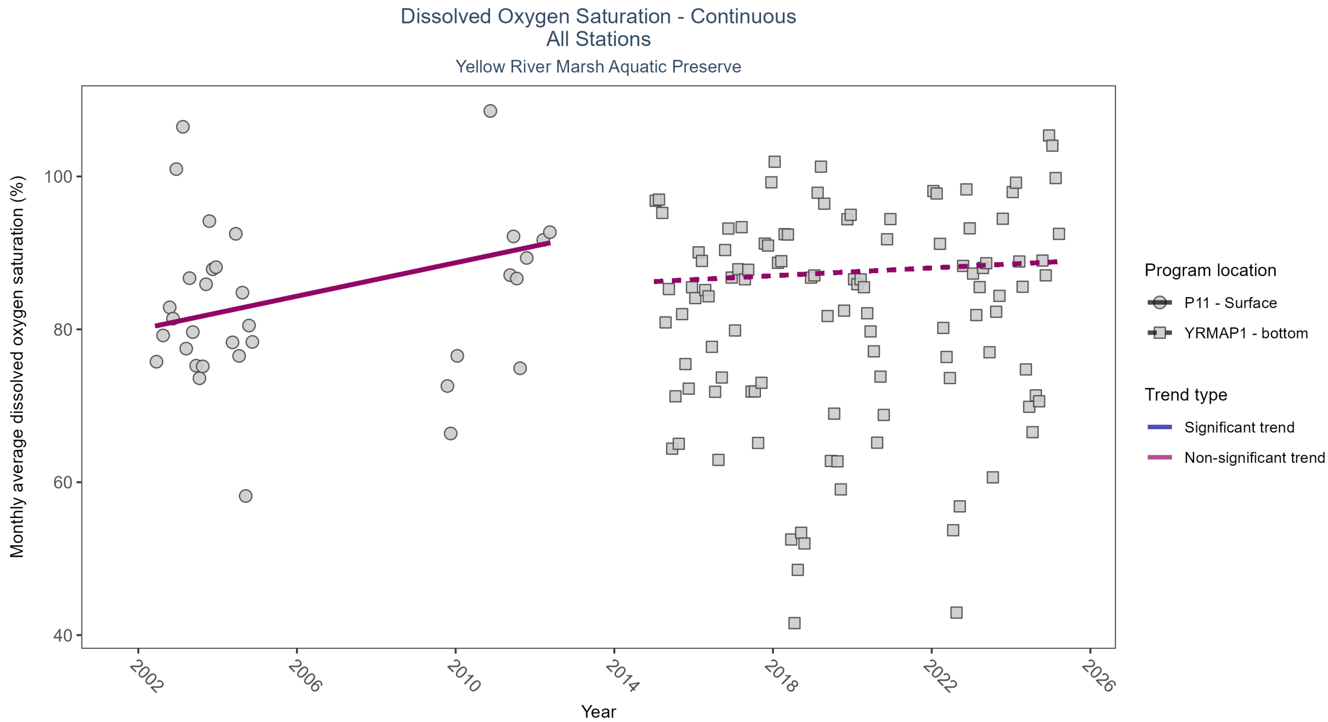

Figure 28: Scatter plot of monthly average dissolved oxygen saturation over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 32: 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	273885	10	2015 - 2025	87.50	0.08	86.25	0.25	0.33
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.

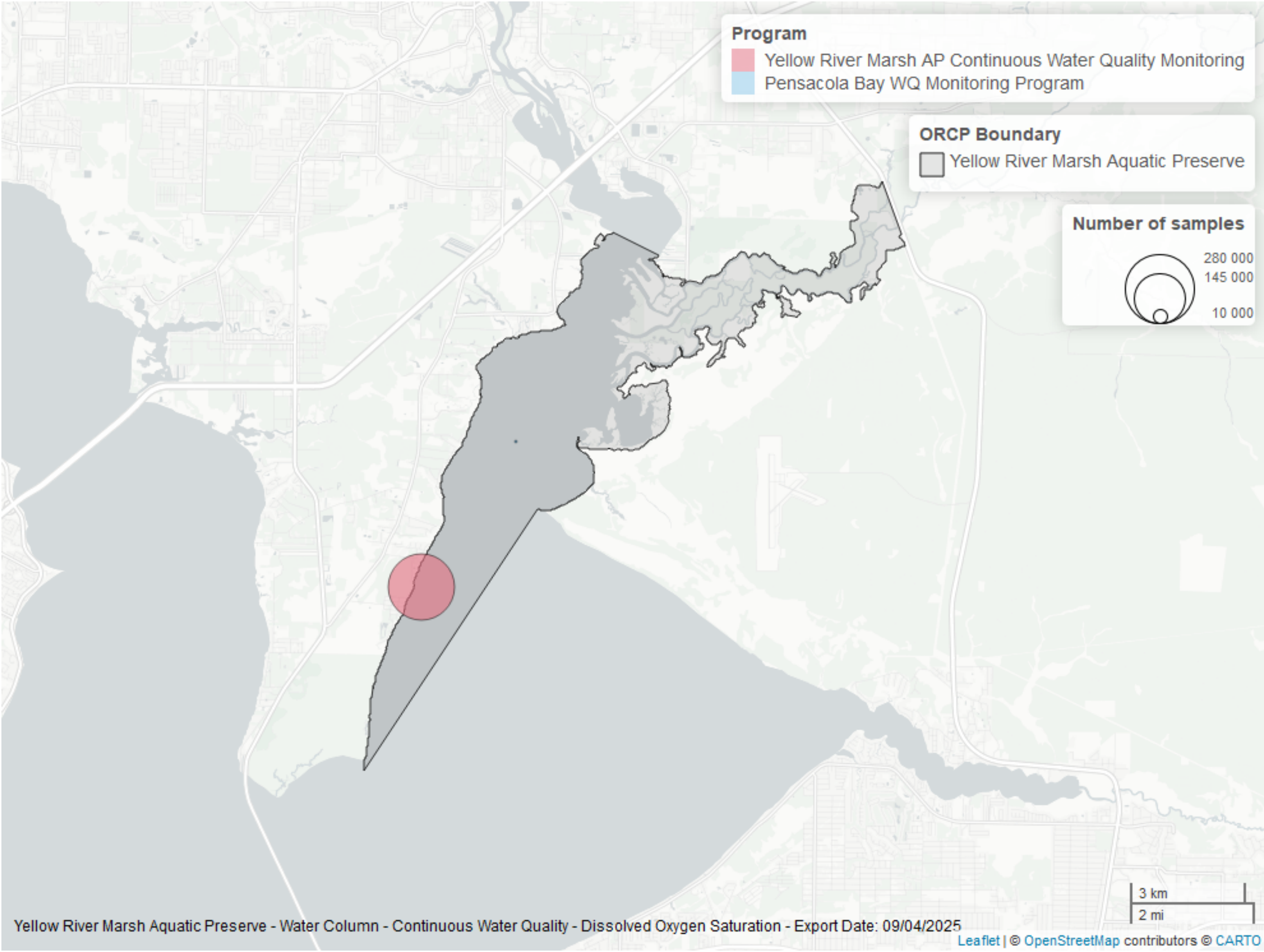

Figure 29: Map showing location of dissolved oxygen saturation continuous water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve.* The bubble size on the maps above reflect the amount of data available at each sampling site.

pH - Continuous

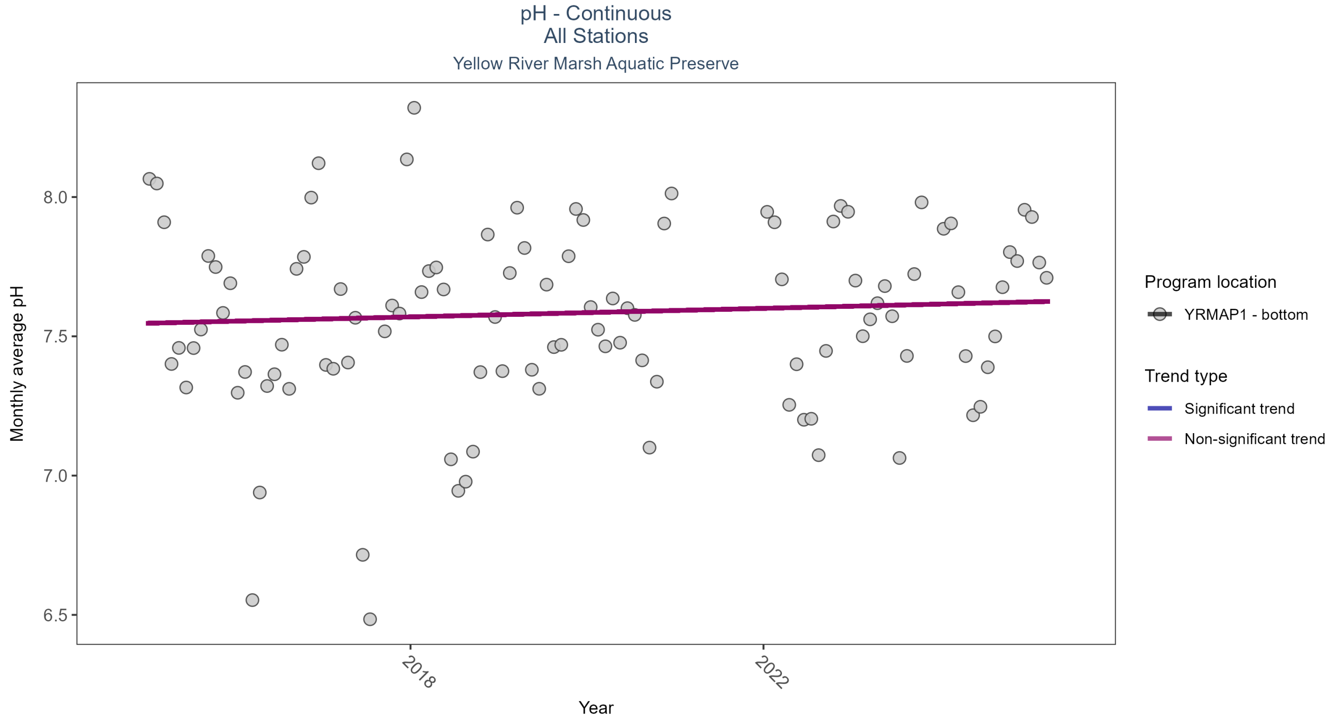

Figure 30: Scatter plot of monthly average pH over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 33: 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	282641	10	2015 - 2025	7.6	0.09	7.55	0.01	0.26

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

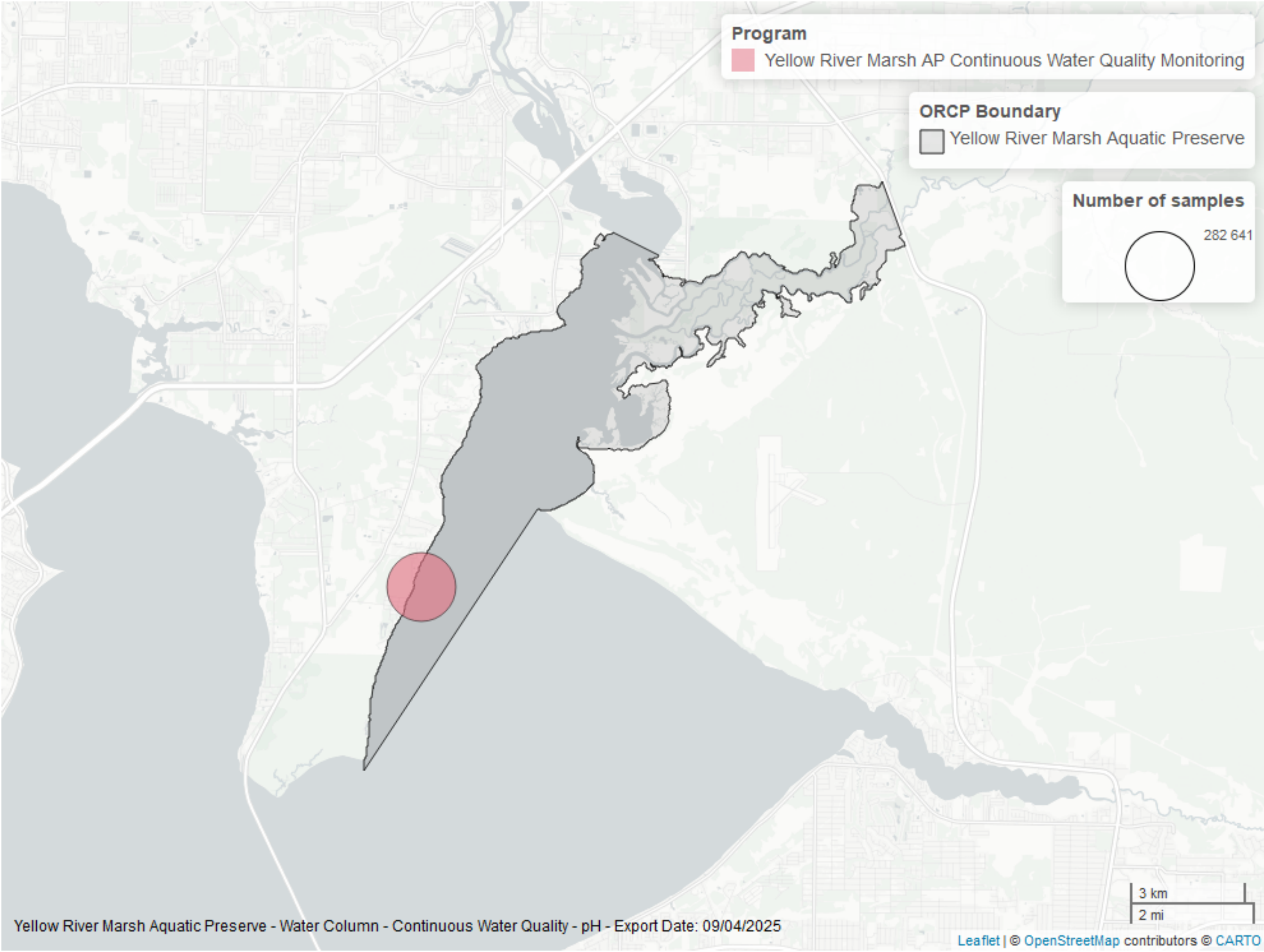

Figure 31: Map showing location of ph continuous water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Salinity - Continuous

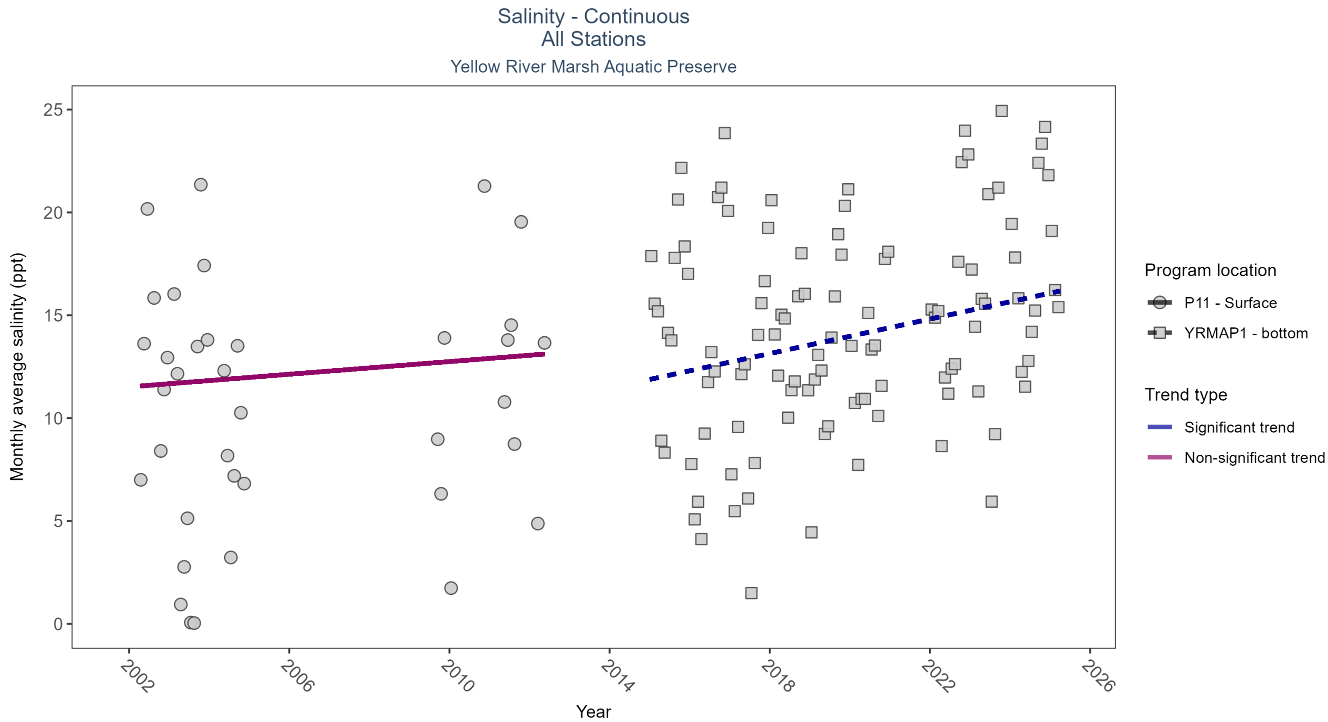

Figure 32: Scatter plot of monthly average salinity over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 34: 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	284295	10	2015 - 2025	14.60	0.28	11.88	0.42	0.00
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 0.42 ppt per year. No detectable change in monthly average salinity was observed at one location.

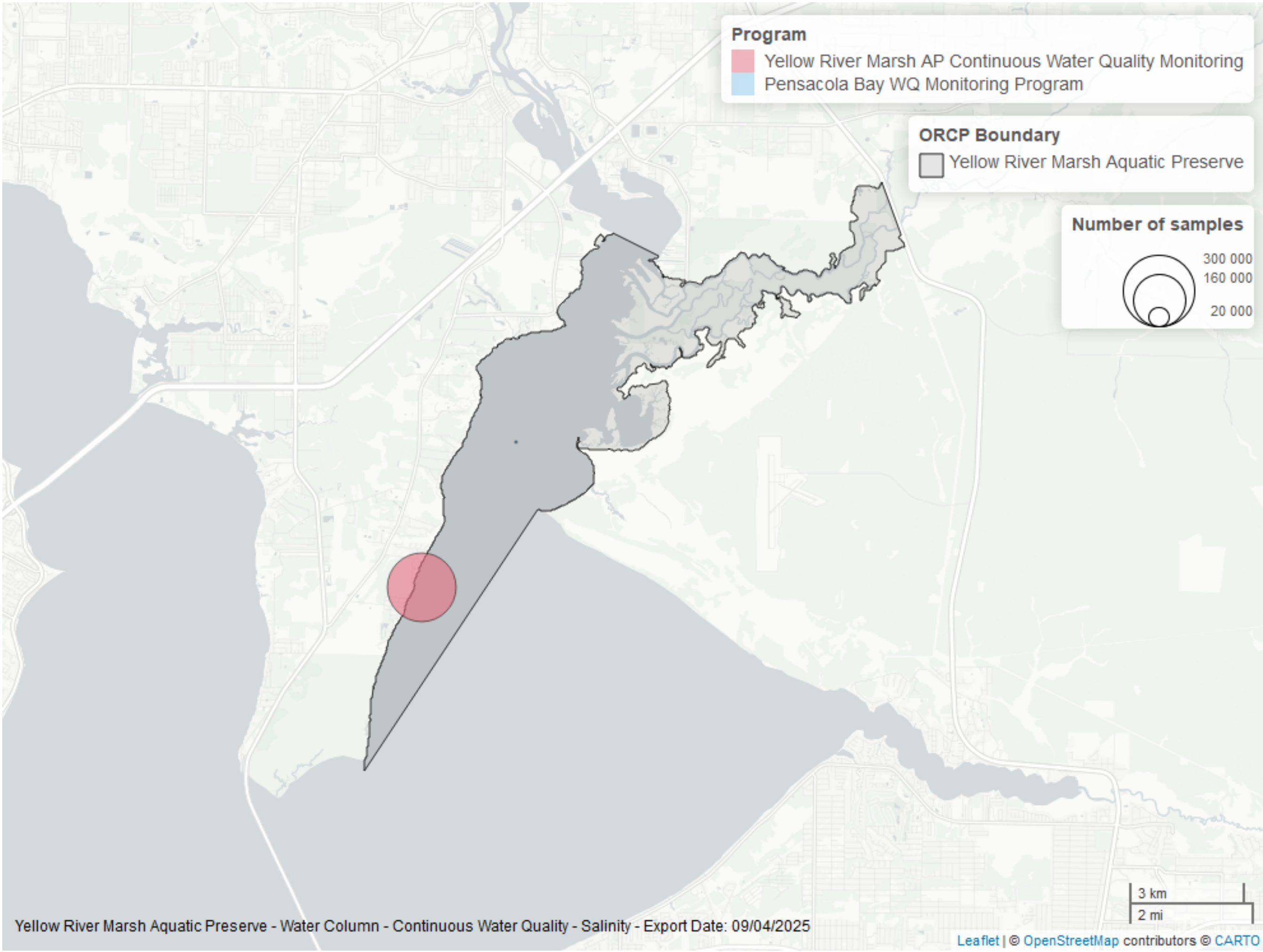

Figure 33: Map showing location of salinity continuous water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Turbidity - Continuous

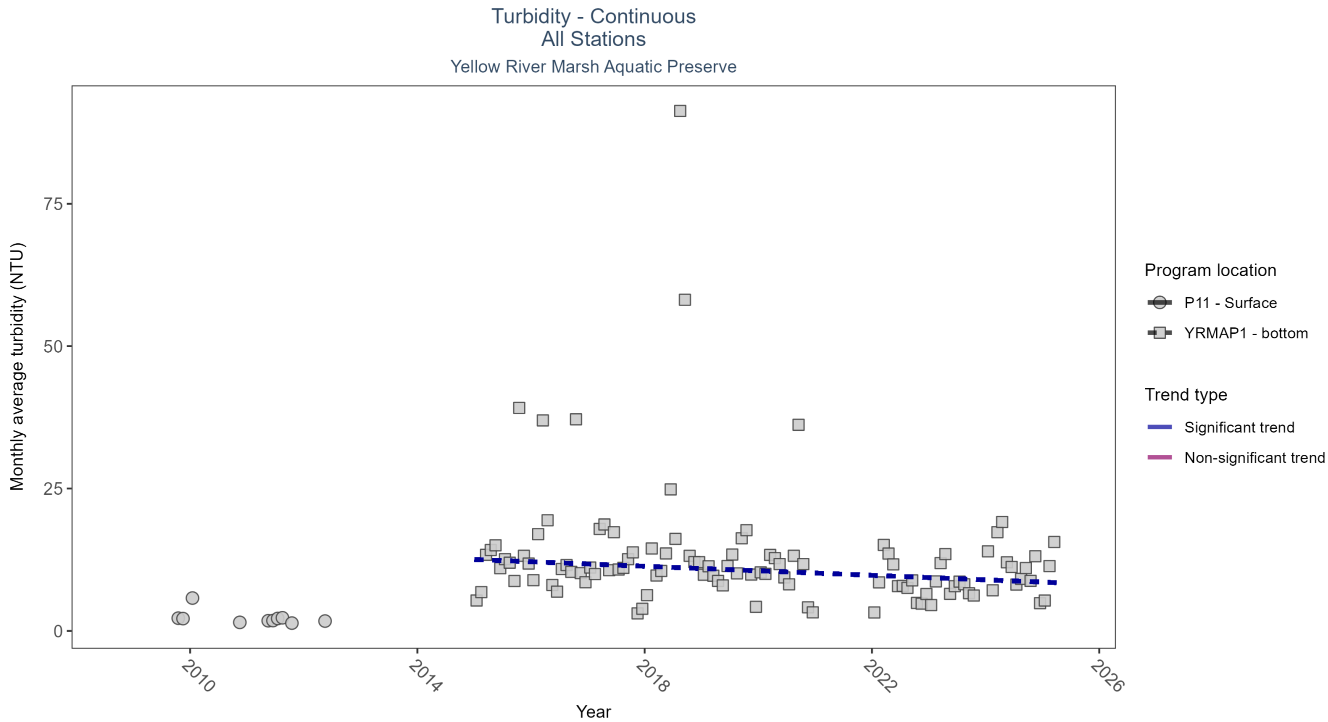

Figure 34: Scatter plot of monthly average turbidity over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 35: 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	296386	10	2015 - 2025	6	-0.22	12.55	-0.4	0.01
P11	Insufficient data to calculate trend	37	4	2009 - 2012	2	-	-	-	-

At one program location, monthly average turbidity decreased by 0.40 NTU per year. There was insufficient data to fit a model for one location.

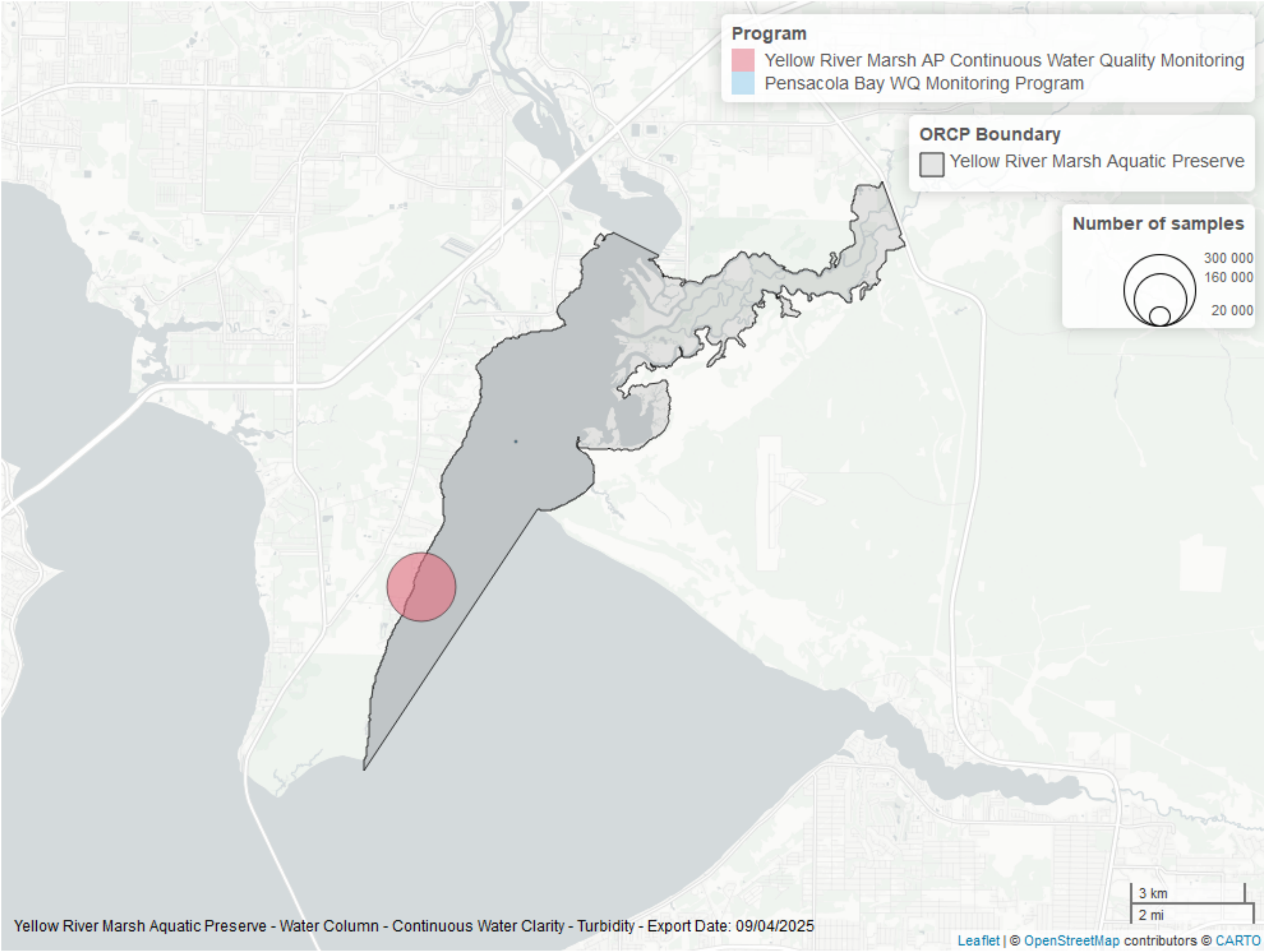

Figure 35: Map showing location of turbidity continuous water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Water Temperature - Continuous

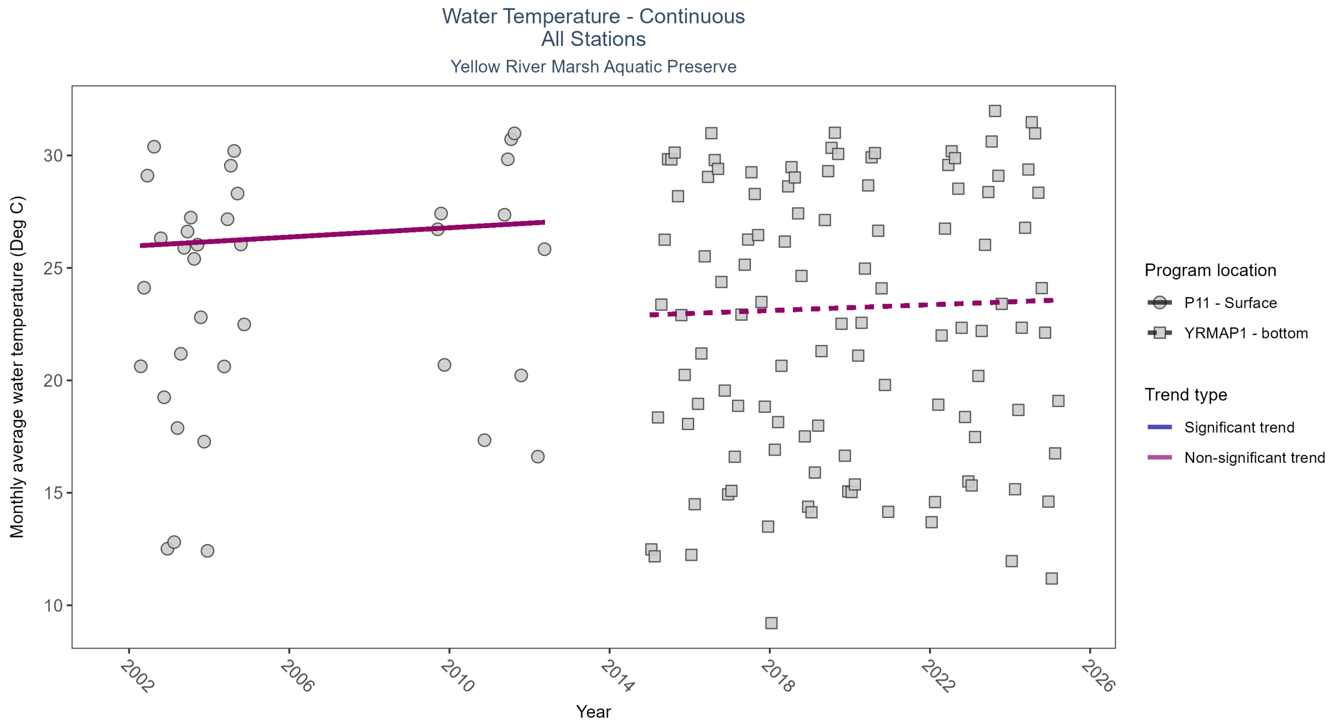

Figure 36: Scatter plot of monthly average water temperature over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 36: 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	309064	10	2015 - 2025	22.80	0.11	22.91	0.06	0.14
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.

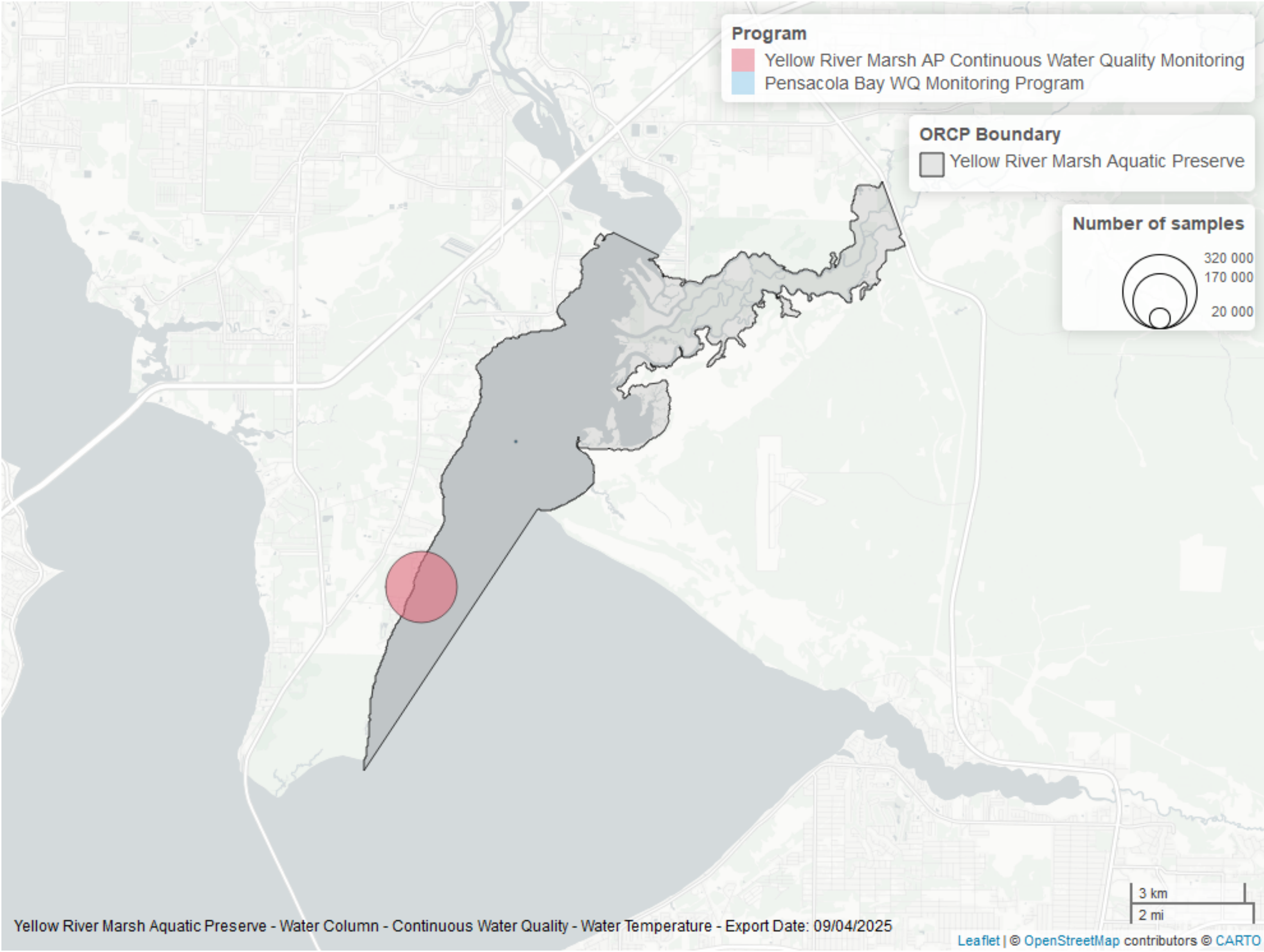

Figure 37: Map showing location of water temperature continuous water quality sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve.* The bubble size on the maps above reflect the amount of data available at each sampling site.

Oyster

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

Density

Restored

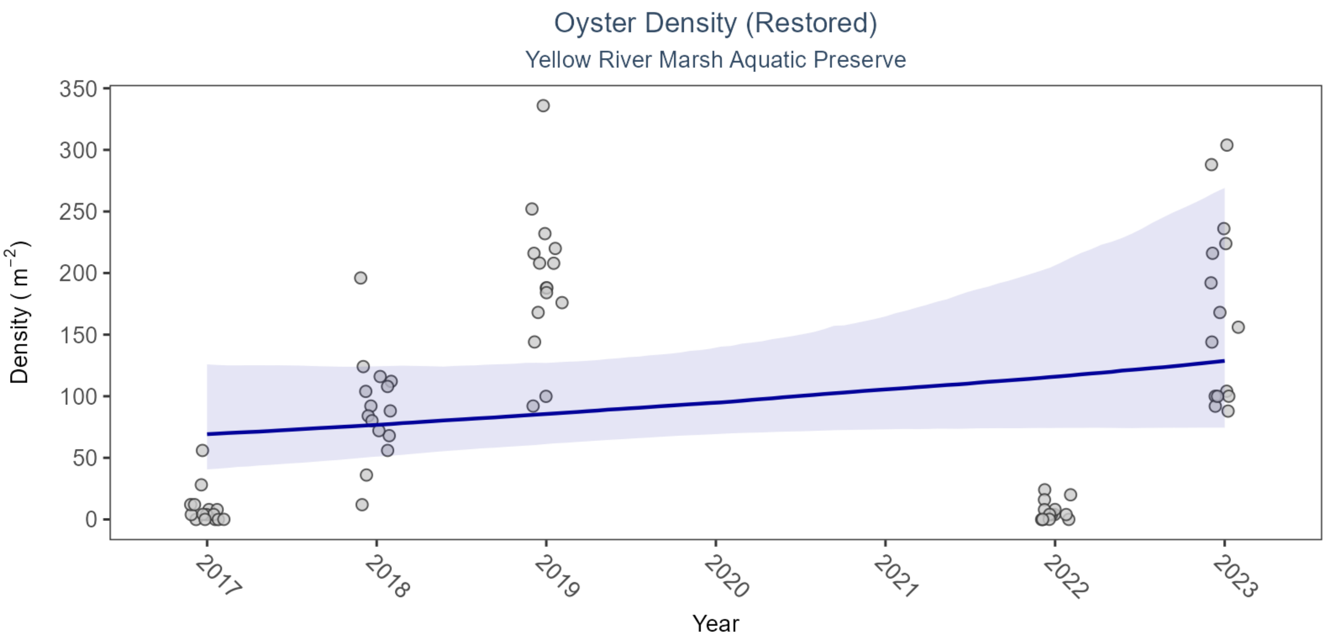

Figure 38: Scatter plot of oyster density over time. If the time series included five or more years with observations, an estimated trend (blue line) and a 95% credible interval (purple band) may also be plotted. Data points are jittered horizontally to reduce overlap.

Table 37: 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.

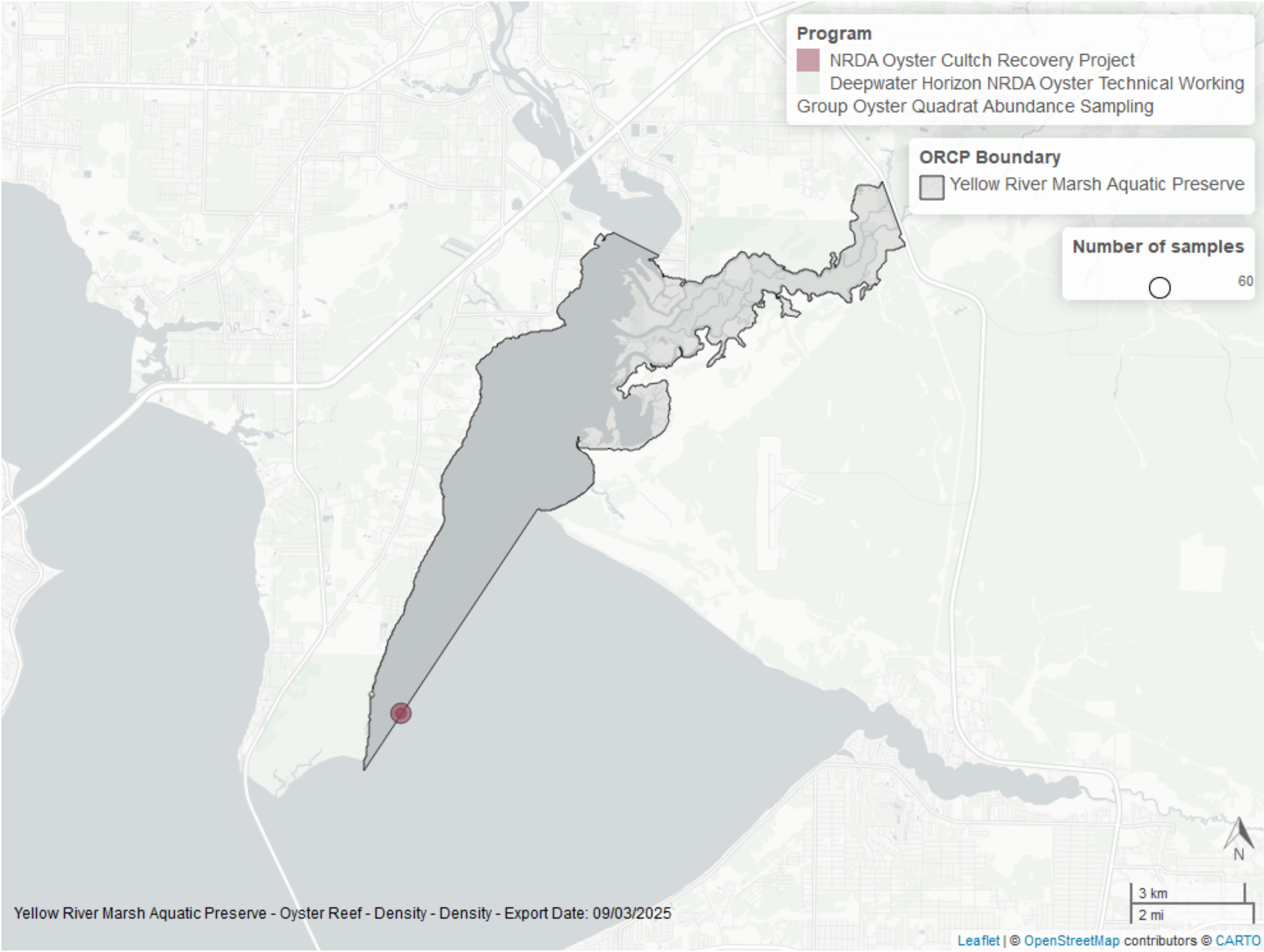

Figure 39: Map showing location of oyster density sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Percent Live

Restored

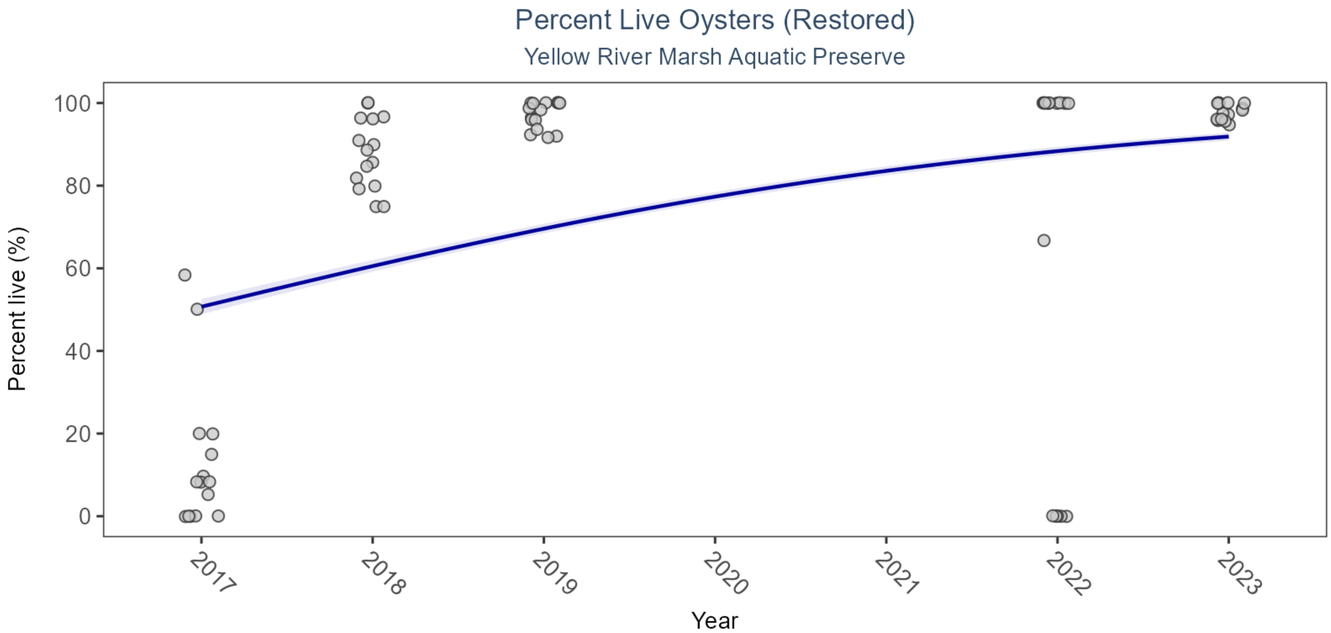

Figure 40: Scatter plot of percent live oysters over time. If the time series included five or more years with observations, an estimated trend (blue line) and a 95% credible interval (purple band) may also be plotted. Data points are jittered horizontally to reduce overlap.

Table 38: Model results for Oyster Percent Live - Restored

Shell Type	*Habitat Type*	*Trend Status*	*Estimate*	*Standard Error*	*Credible Interval*
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.

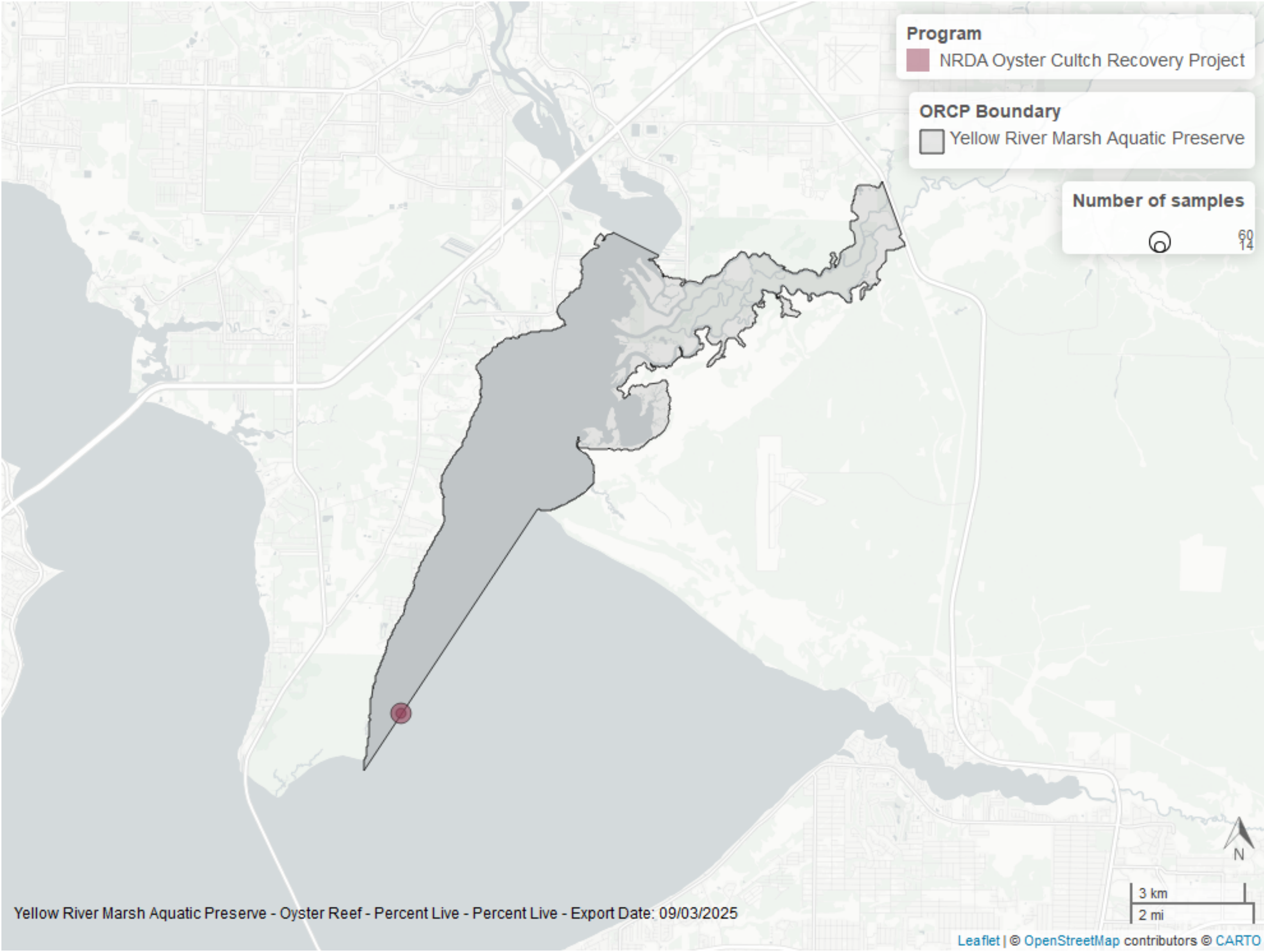

Figure 41: Map showing location of oyster percent live sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Shell Height

Restored

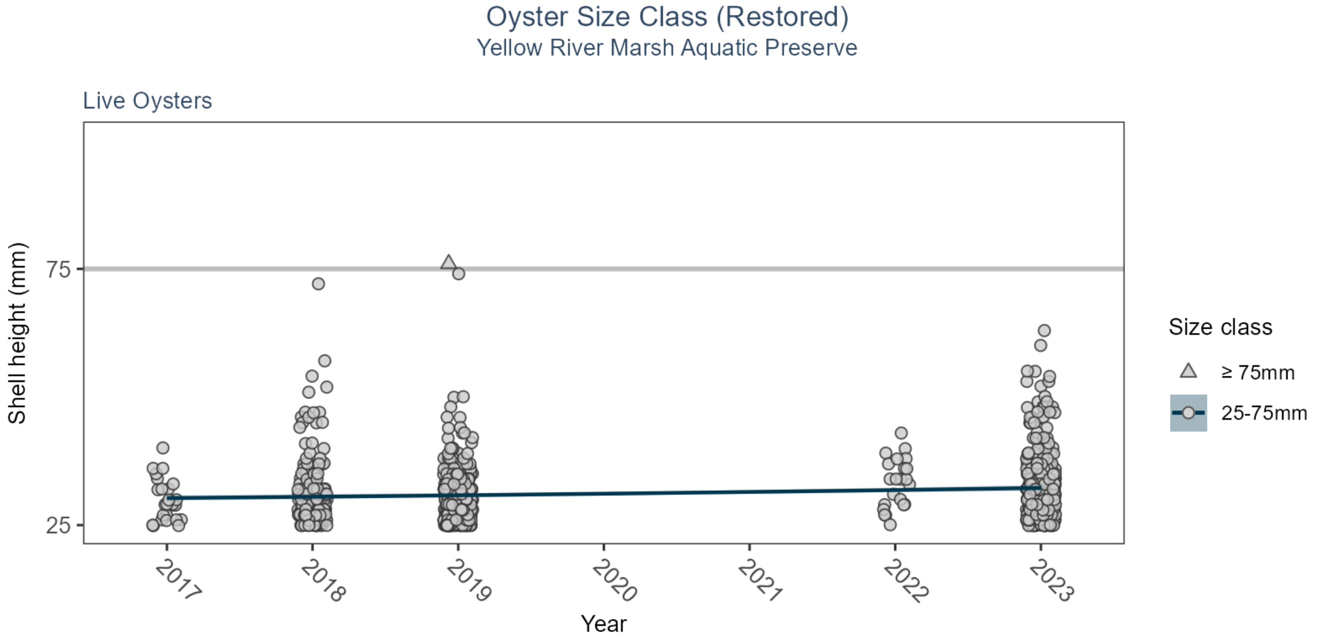

Table 39: Model results for Oyster Shell Height - Restored

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

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

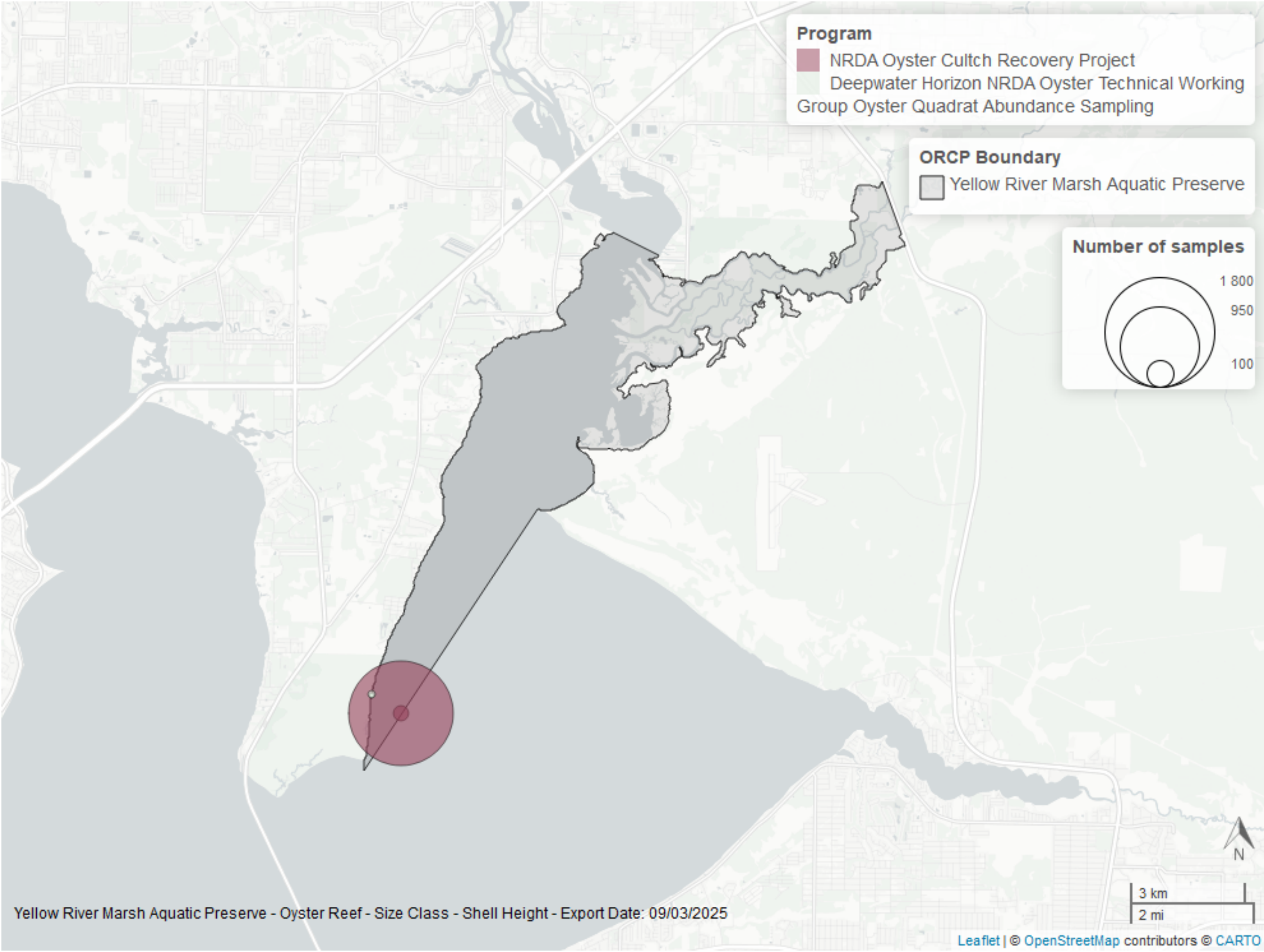

Figure 42: Map showing location of oyster shell height sampling locations within the boundaries of *Yellow River Marsh Aquatic Preserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

References

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).
3. Florida Department of Environmental Protection (DEP). Florida STORET / WIN. (2024).
4. U.S. Environmental Protection Agency (EPA). EPA STOrage and RETrieval Data Warehouse (STORET)/WQX. (2023).
5. U.S. Environmental Protection Agency (EPA); Office of Research and Development. Environmental Monitoring Assessment Program. (2004).
6. 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).
7. University of Florida (UF); Institute of Food and Agricultural Sciences. Florida LAKEWATCH Program. (2024).
8. Florida Fish and Wildlife Conservation Commission (FWC). Fisheries-Independent Monitoring (FIM) Program. (2022).
9. Florida Fish and Wildlife Conservation Commission (FWC); Florida Fish and Wildlife Research Institute (FWRI). Harmful Algal Bloom Marine Observation Network. (2018).
10. Florida Department of Environmental Protection (DEP); Office of Resilience and Coastal Protection (RCP); Central Panhandle Aquatic Preserves. NRDA Oyster Cultch Recovery Project. (2024).
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).