Rookery Bay National Estuarine Research Reserve

SEACAR Habitat Analyses

Last compiled on 22 May, 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	mˆ-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-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

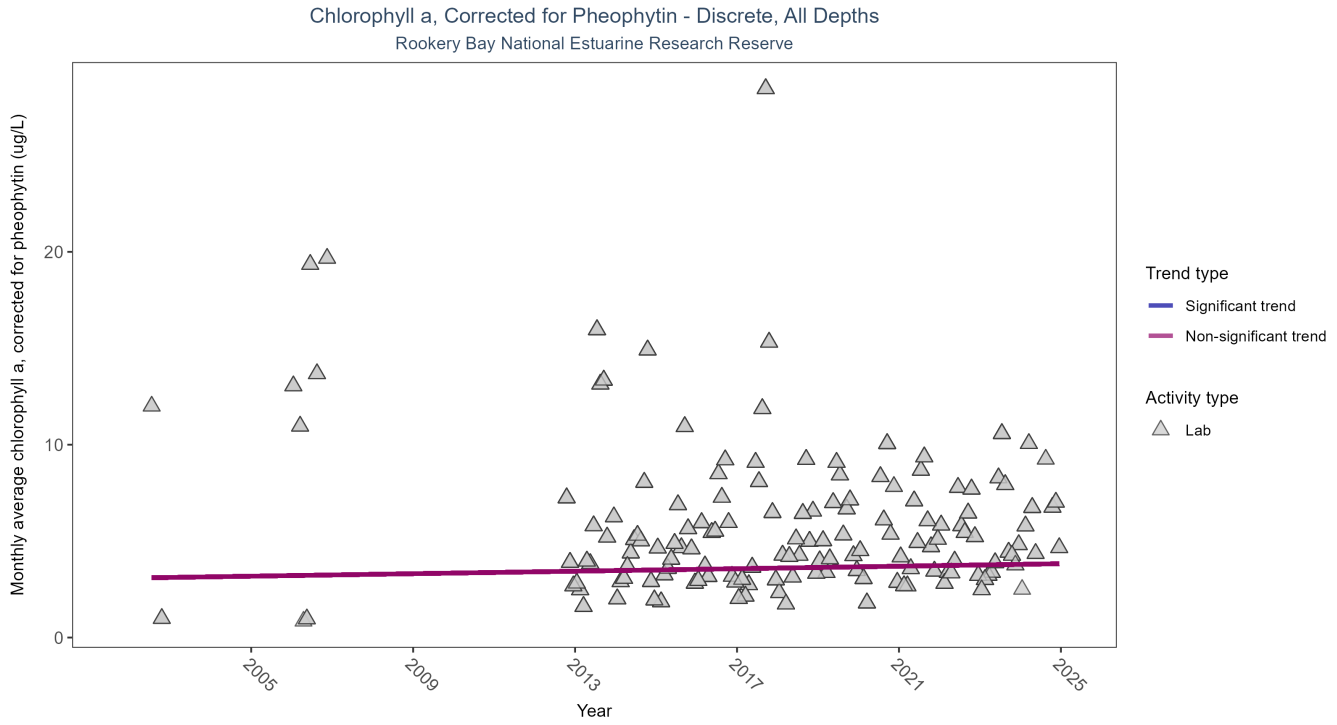

Figure 1: Scatter plot of monthly average levels of chlorophyll a, corrected for pheophytin, over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed chlorophyll a (triangles) 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	No significant trend	2209	15	2002 - 2024	4.1	0.0567	3.084	0.0323	0.3307

Chlorophyll a, corrected for pheophytin, showed no detectable trend between 2002 and 2024.

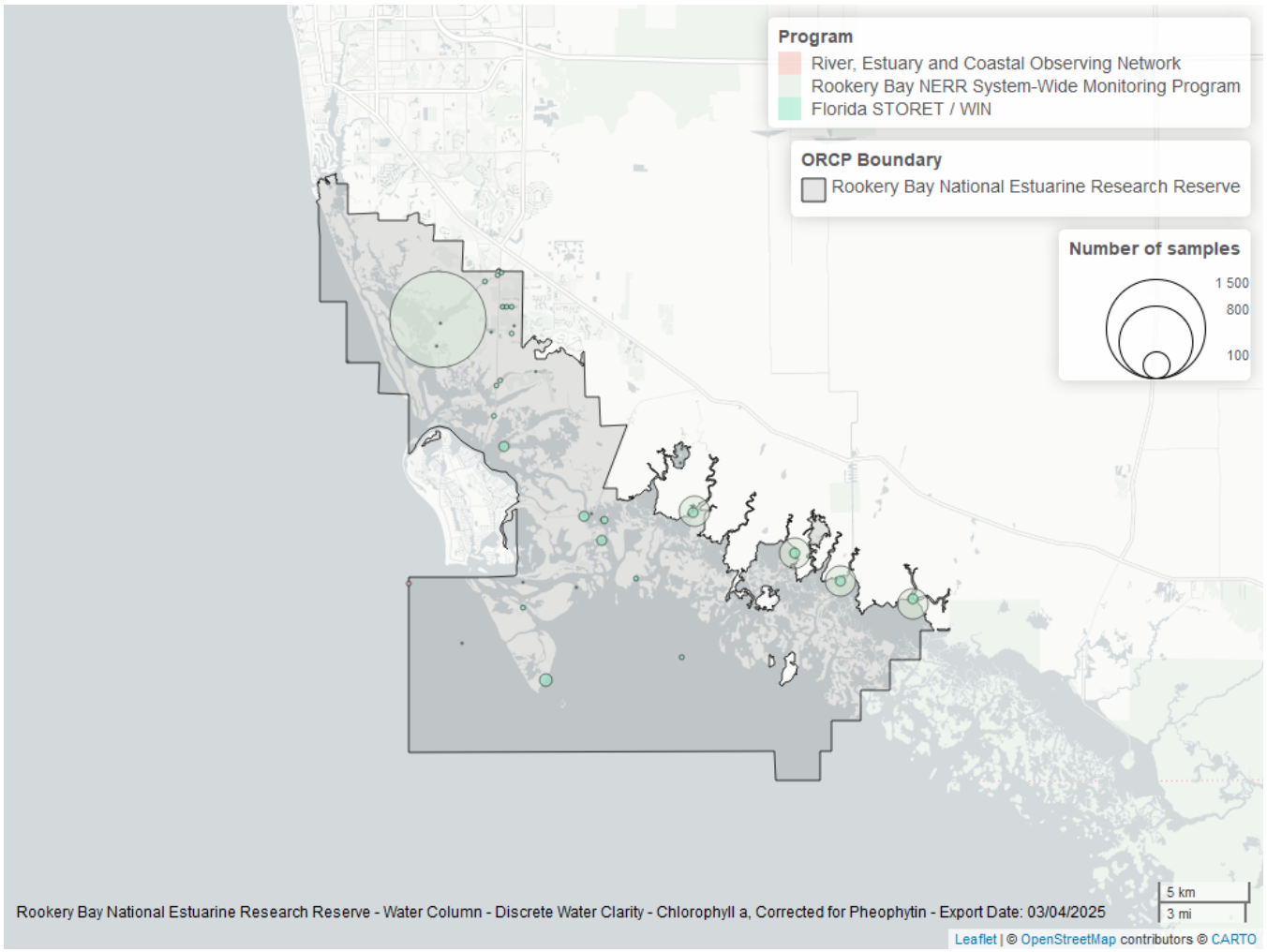

Figure 2: Map showing location of discrete water quality sampling locations within the boundaries of *Rookery Bay National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

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

ProgramID	*N_Data*	*YearMin*	*YearMax*
354	2029	2012	2024
5002	212	2002	2024
303	3	2022	2023

Program names:

303 - River, Estuary and Coastal Observing Network[1]
354 - Rookery Bay National Estuarine Research Reserve System-Wide Monitoring Program[2]
5002 - Florida STORET / WIN[3]

Chlorophyll a, Uncorrected for Pheophytin - Discrete

Seasonal Kendall-Tau Trend Analysis

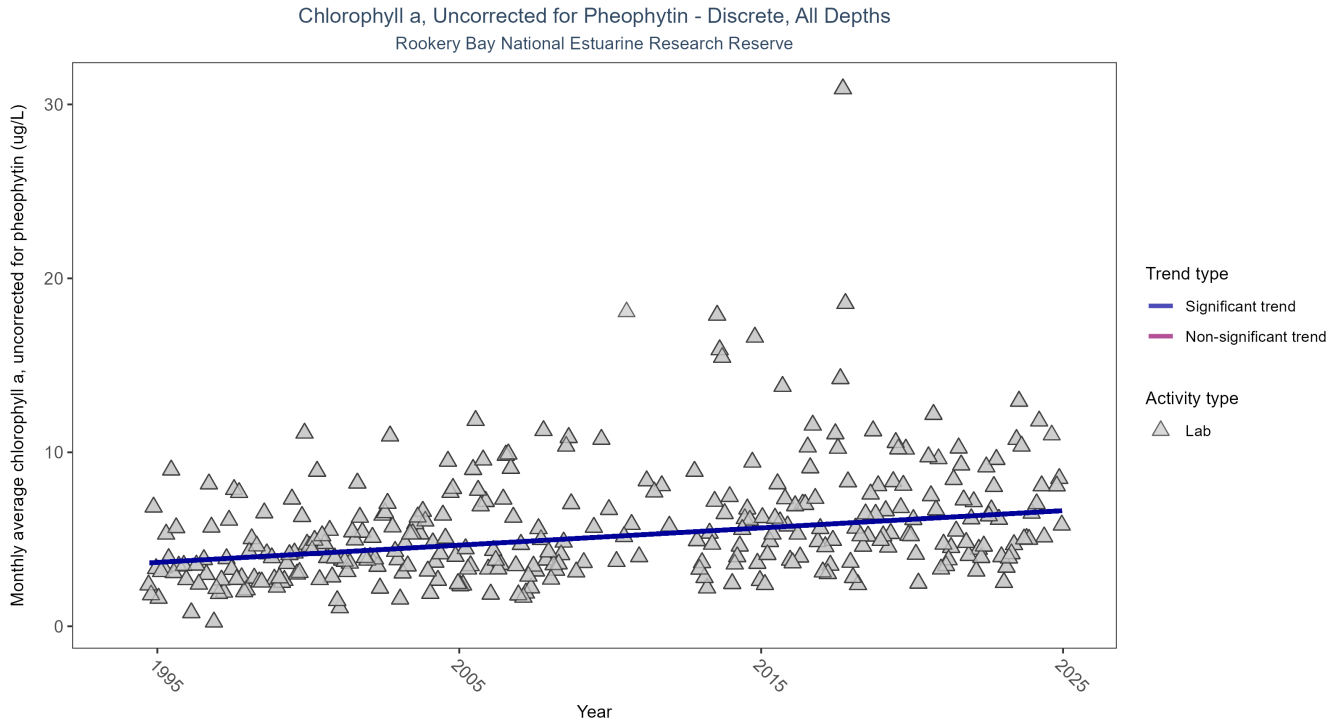

Figure 3: Scatter plot of monthly average levels of chlorophyll a, uncorrected for pheophytin, over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed chlorophyll a (triangles) 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	Significantly increasing trend	5345	31	1994 - 2024	4.4	0.3358	3.5724	0.0992	0

Monthly average chlorophyll a, uncorrected for pheophytin, increased by 0.1 µg/L per year, indicating a decrease in water clarity.

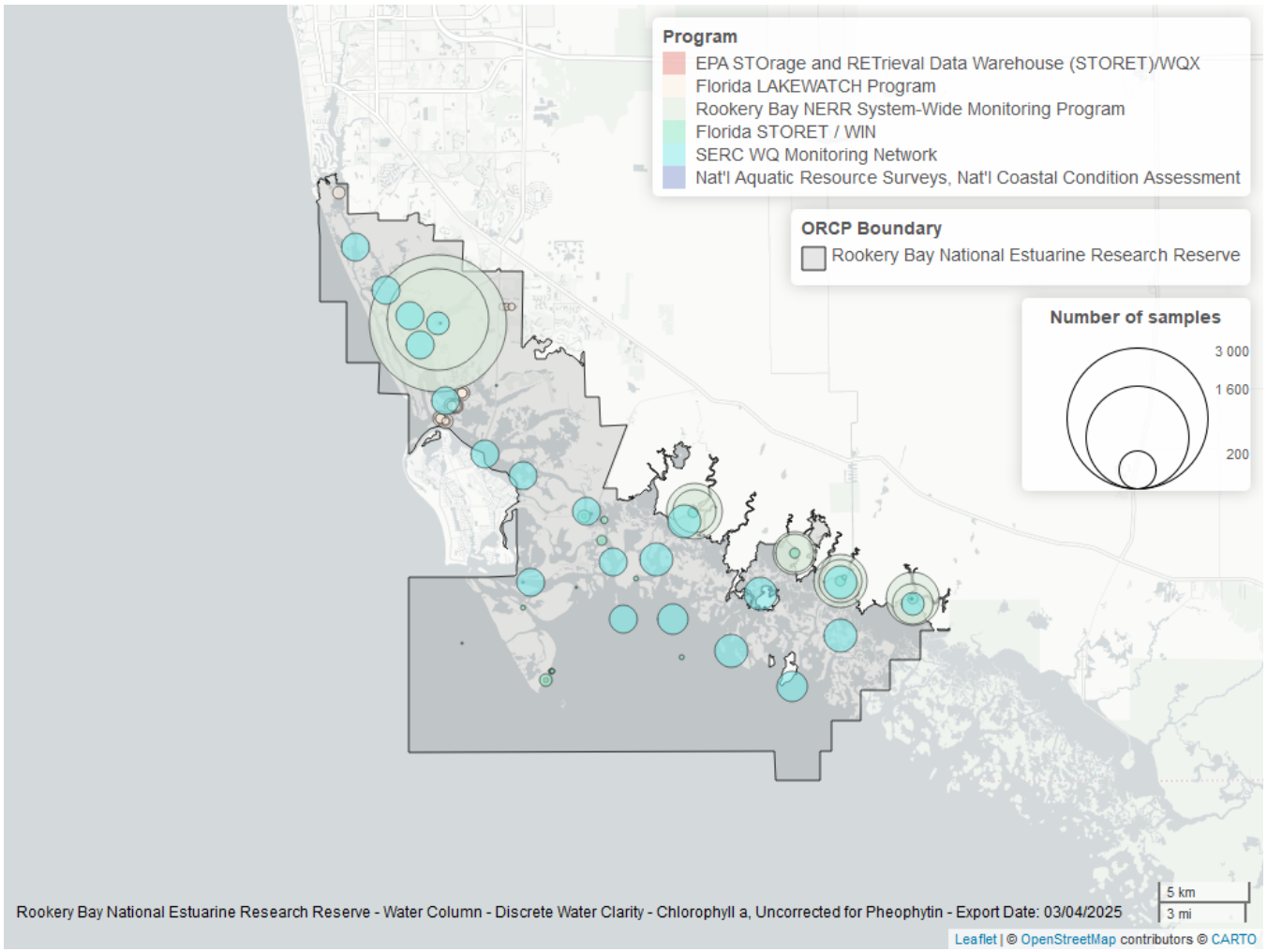

Figure 4: Map showing location of discrete water quality sampling locations within the boundaries of *Rookery Bay National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

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

ProgramID	*N_Data*	*YearMin*	*YearMax*
354	7218	2002	2024
509	2746	1994	2008
514	413	2001	2017
5002	173	2001	2024
103	35	2021	2021
118	1	2010	2010

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[4]
118 - National Aquatic Resource Surveys, National Coastal Condition Assessment[5]
354 - Rookery Bay National Estuarine Research Reserve System-Wide Monitoring Program[2]
509 - SERC Water Quality Monitoring Network[6]
514 - Florida LAKEWATCH Program[7]
5002 - Florida STORET / WIN[3]

Colored Dissolved Organic Matter - Discrete

Seasonal Kendall-Tau Trend Analysis

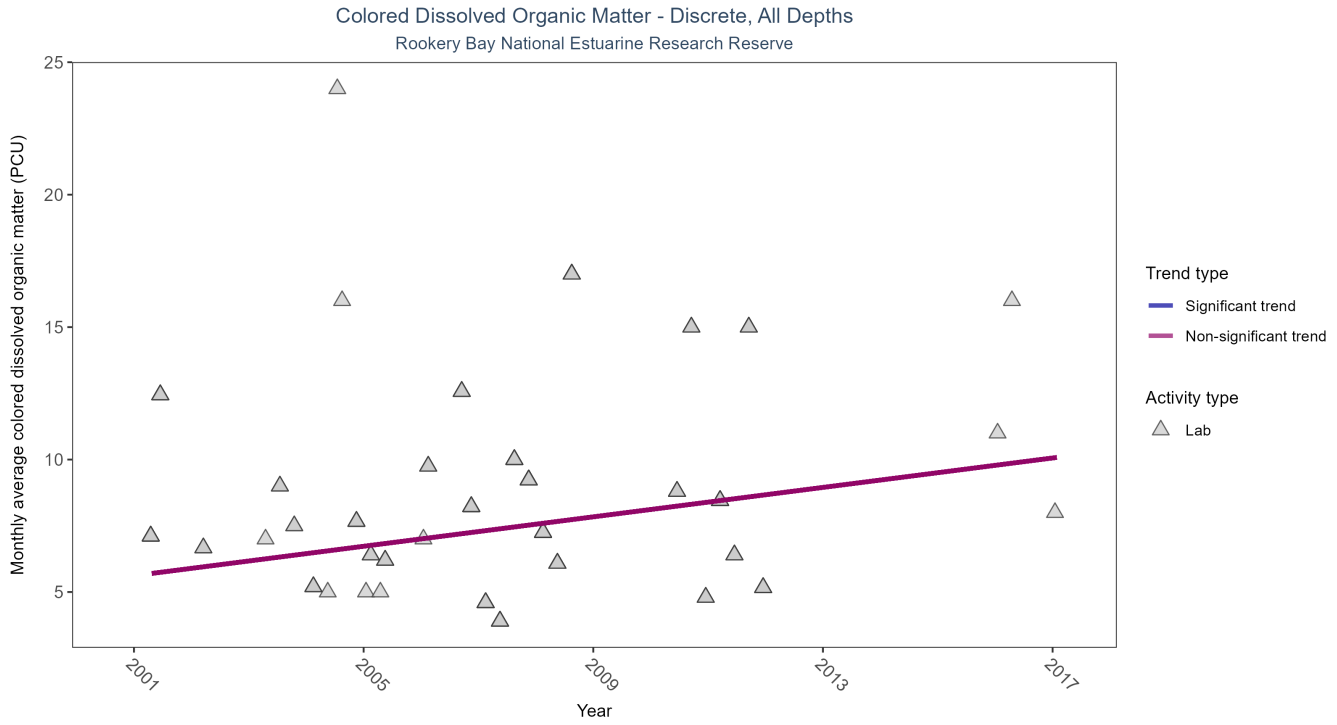

Figure 5: Scatter plot of monthly average colored dissolved organic matter (CDOM) over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only laboratory-analyzed CDOM (triangles) is included in the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

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

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Lab	No significant trend	193	12	2001 - 2017	8	0.3619	5.6154	0.2778	0.1533

Colored dissolved organic matter showed no detectable trend between 2001 and 2017.

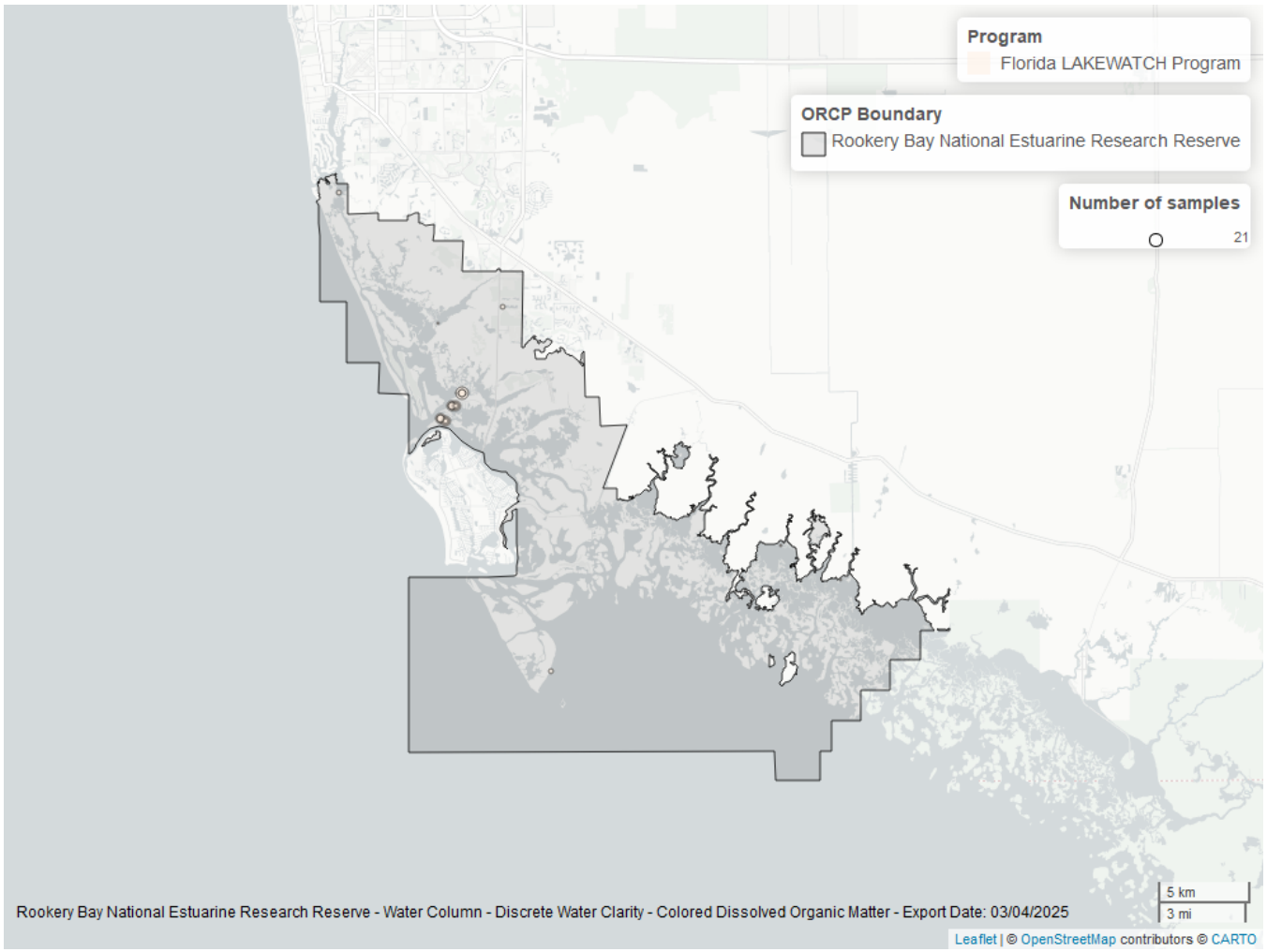

Figure 6: Map showing location of discrete water quality sampling locations within the boundaries of *Rookery Bay National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 11: Programs contributing data for Colored Dissolved Organic Matter

ProgramID	*N_Data*	*YearMin*	*YearMax*
514	193	2001	2017

Program names:

514 - Florida LAKEWATCH Program[7]

Dissolved Oxygen - Discrete

Seasonal Kendall-Tau Trend Analysis

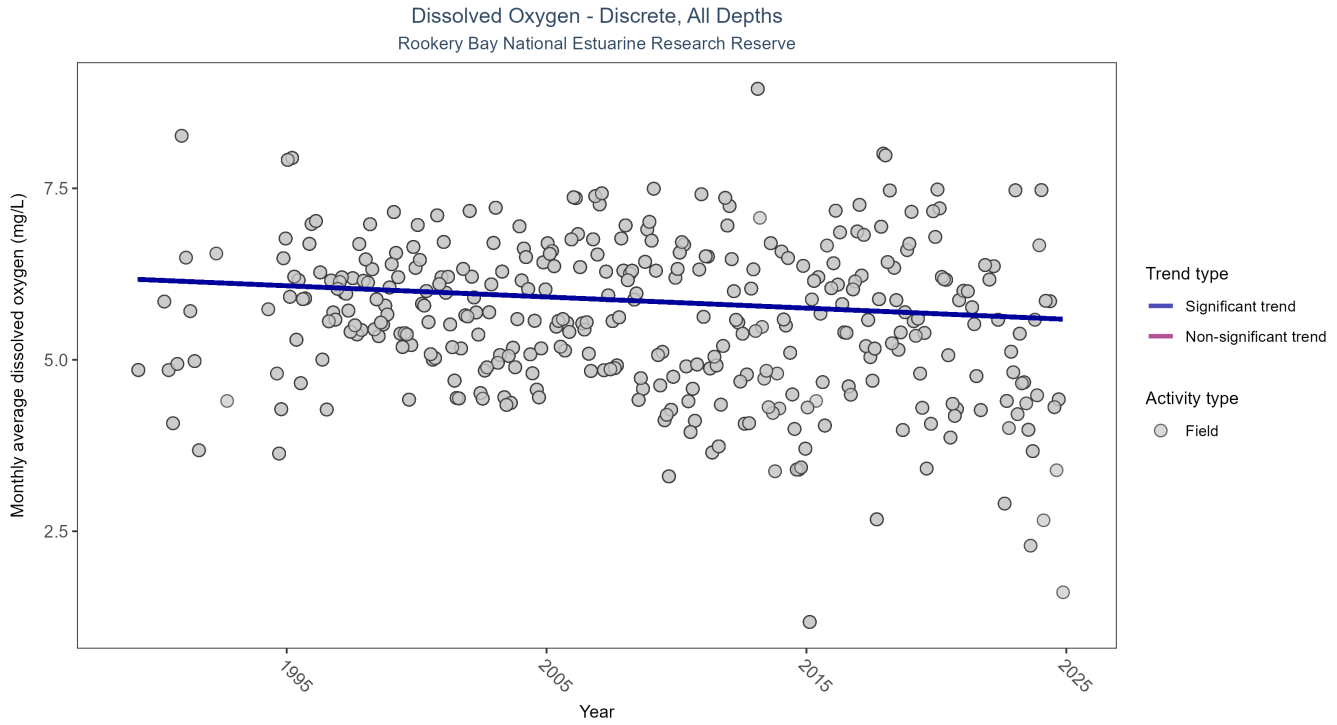

Figure 7: Scatter plot of monthly average dissolved oxygen over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only dissolved oxygen values measured in the field (circles) are included in the plot.

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

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Field	Significantly decreasing trend	15353	35	1989 - 2024	5.8	-0.1257	6.1775	-0.0163	0.0006

Monthly average dissolved oxygen decreased by 0.02 mg/L per year.

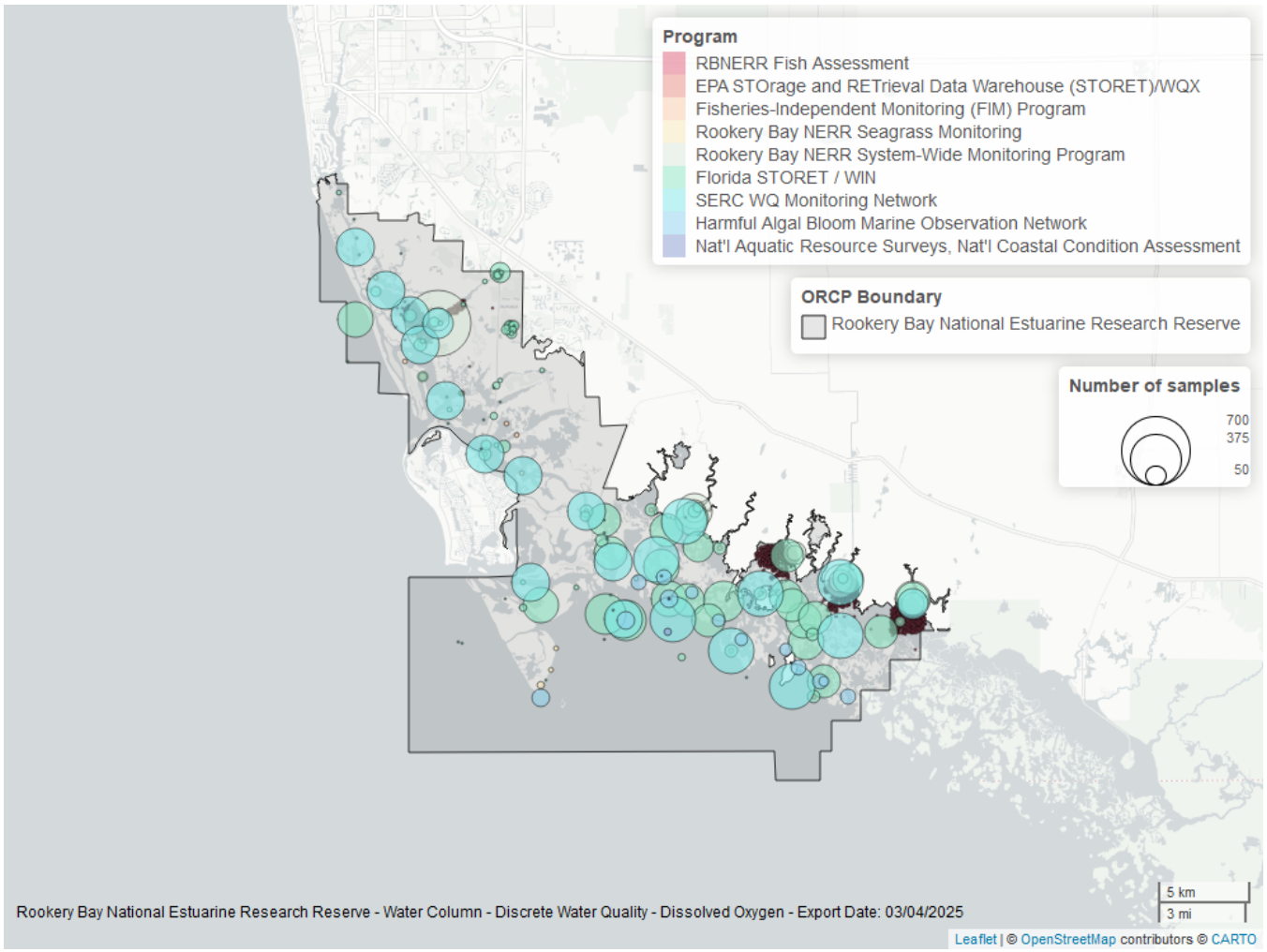

Figure 8: Map showing location of discrete water quality sampling locations within the boundaries of *Rookery Bay National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 13: Programs contributing data for Dissolved Oxygen

ProgramID	*N_Data*	*YearMin*	*YearMax*
509	5403	1994	2008
5002	5170	1989	2024
4043	2975	1999	2020
354	1651	2002	2023
95	442	1997	2018
103	80	2021	2021
572	27	1998	2005
69	22	2001	2001
118	10	2015	2021

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]

118 - National Aquatic Resource Surveys, National Coastal Condition Assessment[5]
354 - Rookery Bay National Estuarine Research Reserve System-Wide Monitoring Program[2]
509 - SERC Water Quality Monitoring Network[6]
572 - Rookery Bay National Estuarine Research Reserve Seagrass Monitoring[10]
4043 - RBNERR Fish Assessment[11]
5002 - Florida STORET / WIN[3]

Dissolved Oxygen Saturation - Discrete

Seasonal Kendall-Tau Trend Analysis

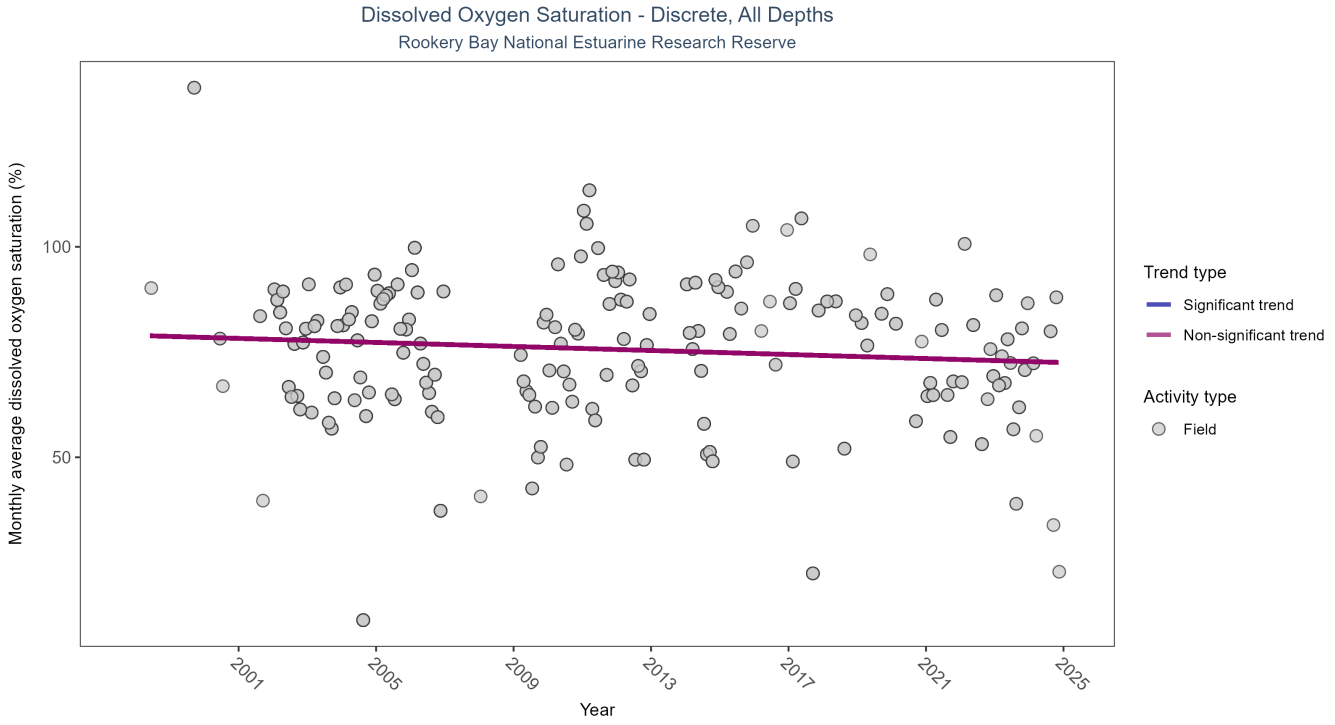

Figure 9: Scatter plot of monthly average dissolved oxygen saturation over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only dissolved oxygen saturation values measured in the field (circles)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

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

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Field	No significant trend	1402	25	1998 - 2024	78	-0.0882	78.9552	-0.2391	0.1253

Dissolved oxygen saturation showed no detectable trend between 1998 and 2024.

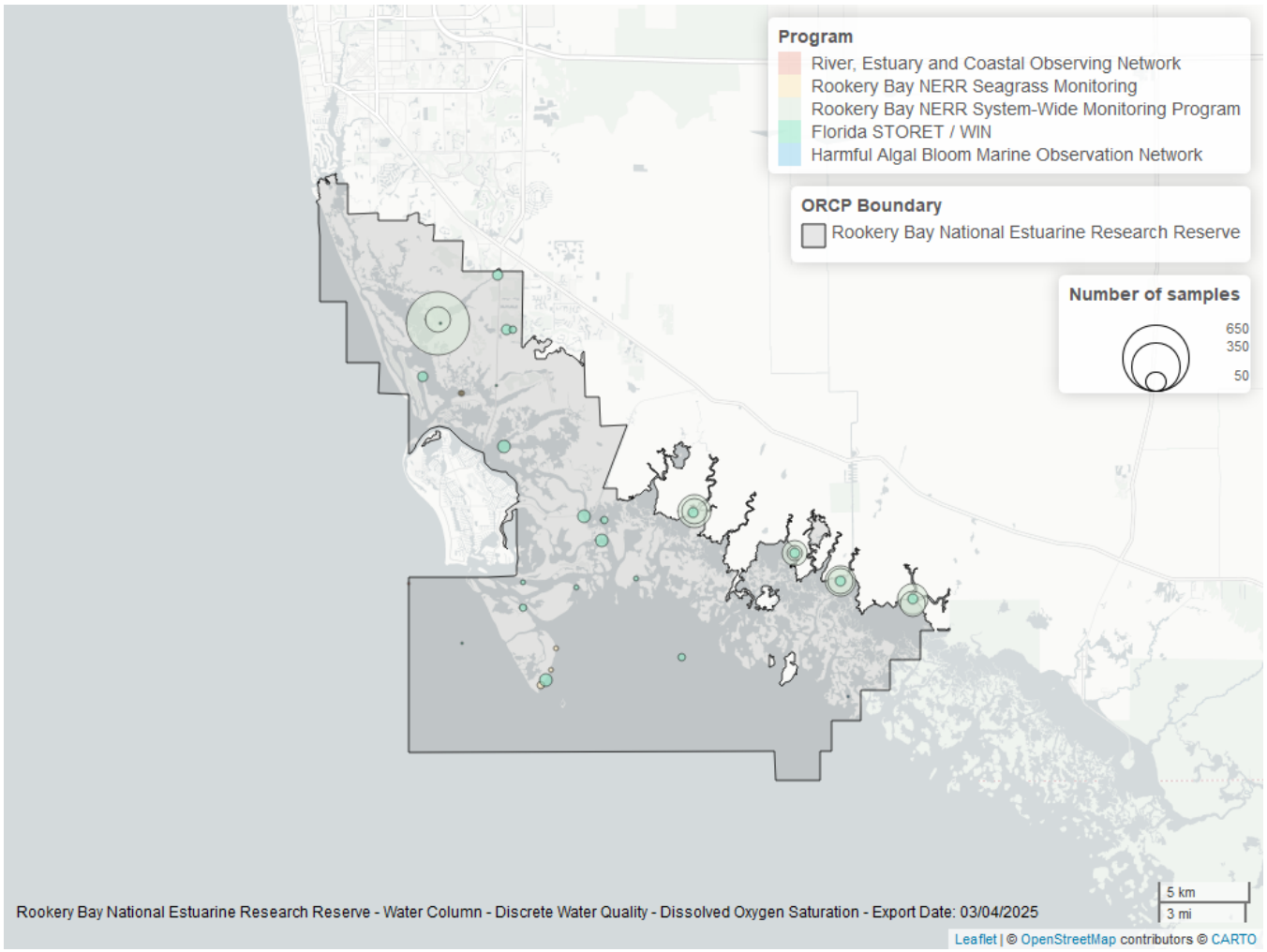

Figure 10: Map showing location of discrete water quality sampling locations within the boundaries of *Rookery Bay National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 15: Programs contributing data for Dissolved Oxygen Saturation

ProgramID	*N_Data*	*YearMin*	*YearMax*
354	1582	2002	2024
5002	255	2015	2024
572	27	1998	2005
95	1	2008	2008
303	1	2023	2023

Program names:

95 - Harmful Algal Bloom Marine Observation Network[9]
303 - River, Estuary and Coastal Observing Network[1]
354 - Rookery Bay National Estuarine Research Reserve System-Wide Monitoring Program[2]
572 - Rookery Bay National Estuarine Research Reserve Seagrass Monitoring[10]
5002 - Florida STORET / WIN[3]

pH - Discrete

Seasonal Kendall-Tau Trend Analysis

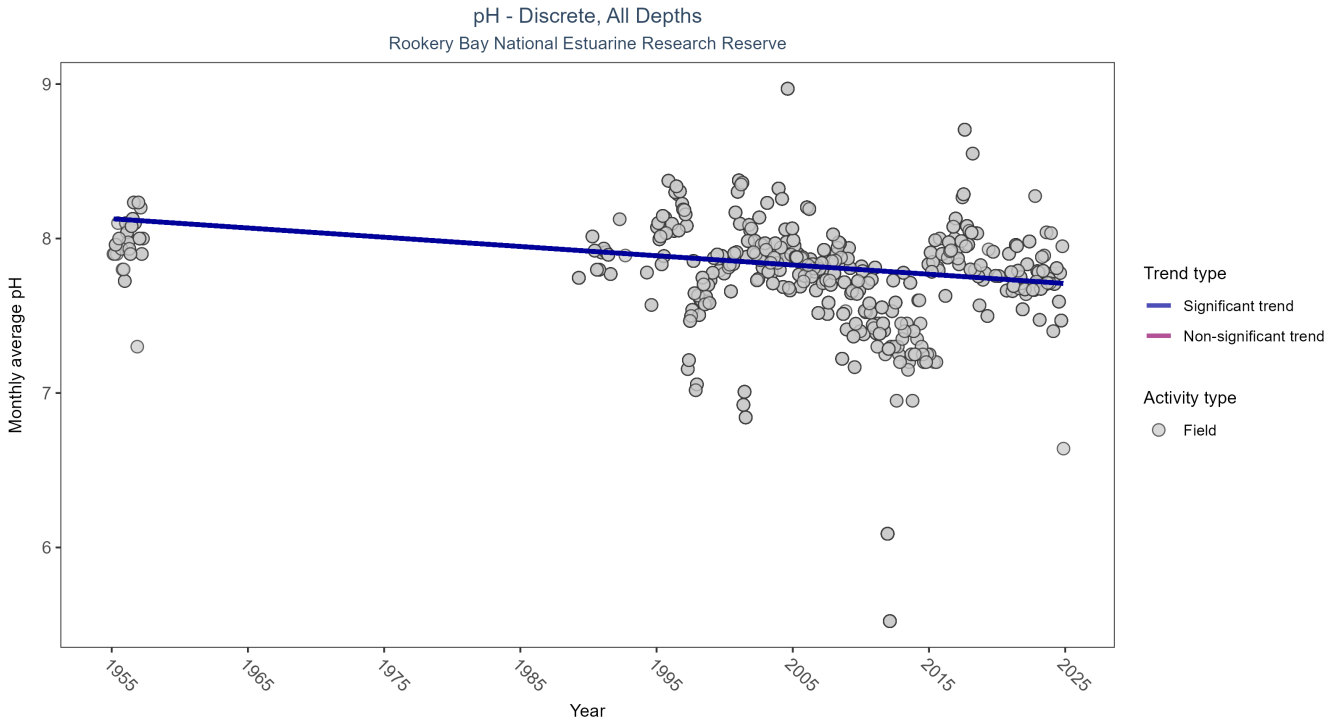

Figure 11: Scatter plot of monthly average pH over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only pH values measured in the field (circles) are included in the plot.

Table 16: Seasonal Kendall-Tau Trend Analysis for pH

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Field	Significantly decreasing trend	7368	38	1955 - 2024	7.86	-0.2239	8.1282	-0.006	0

Monthly average pH decreased by 0.01 pH units per year.

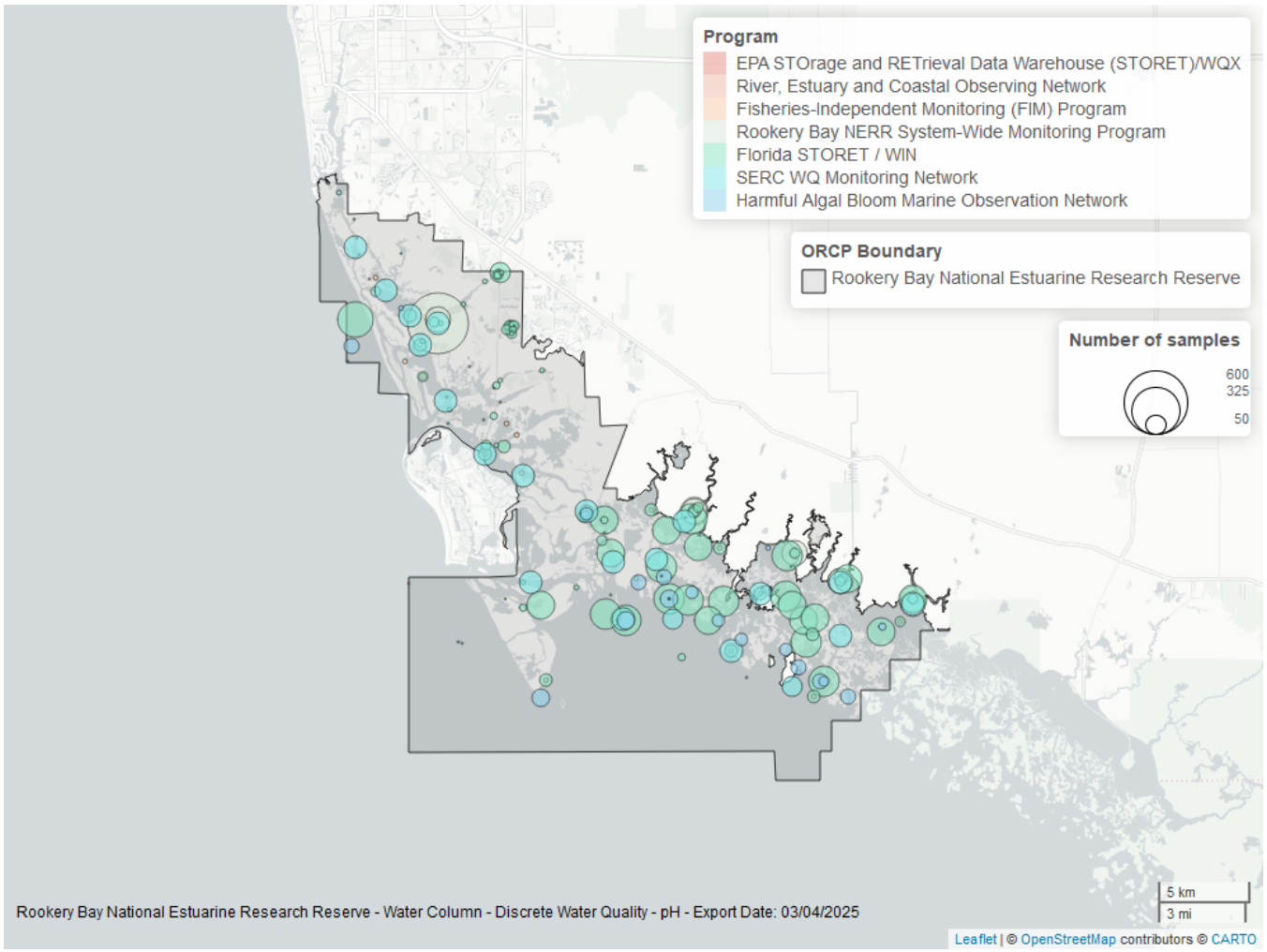

Figure 12: Map showing location of discrete water quality sampling locations within the boundaries of *Rookery Bay National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 17: Programs contributing data for pH

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	4127	1989	2024
509	1719	2001	2008
354	1400	2002	2024
95	514	1955	2018
103	103	2021	2021
69	22	2001	2001
303	1	2023	2023

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]
303 - River, Estuary and Coastal Observing Network[1]
354 - Rookery Bay National Estuarine Research Reserve System-Wide Monitoring Program[2]

509 - SERC Water Quality Monitoring Network[6]
5002 - Florida STORET / WIN[3]

Salinity - Discrete

Seasonal Kendall-Tau Trend Analysis

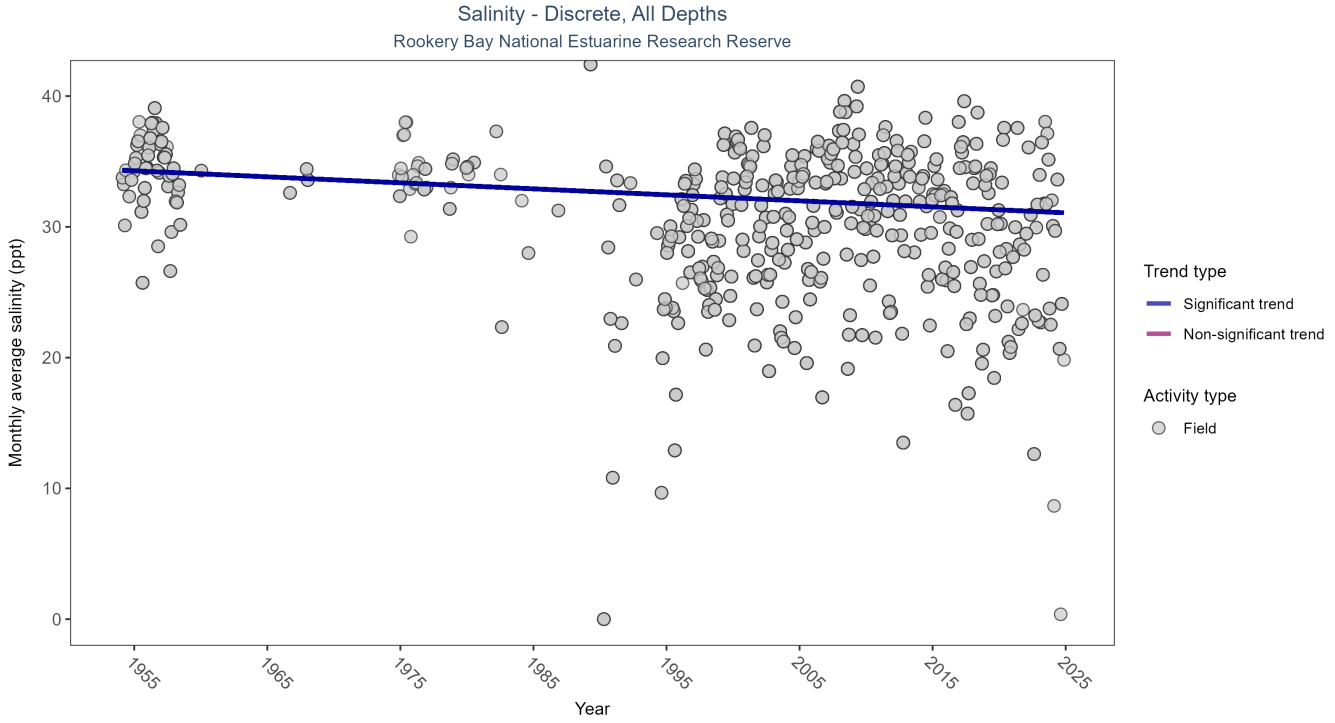

Figure 13: Scatter plot of monthly average salinity over time. If the time series included ten or more years of discrete observations, significant (blue) or non-significant (magenta) trend lines are also shown. Discrete salinity values derived from grab samples analyzed in the field (circles) or the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

Table 18: Seasonal Kendall-Tau Trend Analysis for Salinity

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
All	Significantly decreasing trend	16814	53	1954 - 2024	32.7	-0.1588	34.3313	-0.0459	0

Monthly average salinity decreased by 0.05 ppt per year.

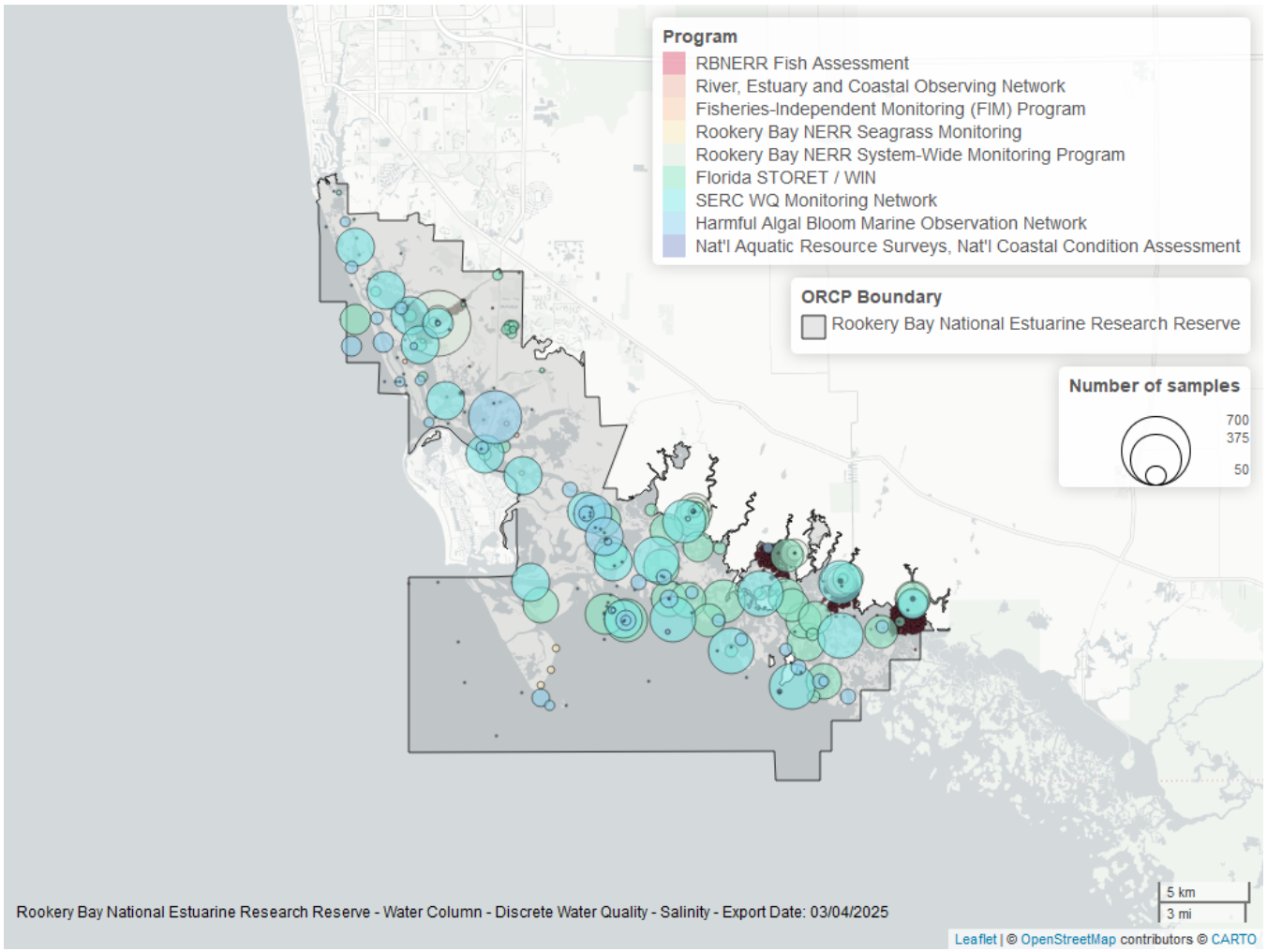

Figure 14: Map showing location of discrete water quality sampling locations within the boundaries of *Rookery Bay National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 19: Programs contributing data for Salinity

ProgramID	*N_Data*	*YearMin*	*YearMax*
509	5387	1994	2008
5002	5161	1989	2024
4043	3045	1999	2020
354	1929	2002	2024
95	1890	1954	2018
572	31	1998	2005
69	22	2001	2001
118	8	2015	2021
303	1	2023	2023

Program names:

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

303 - River, Estuary and Coastal Observing Network[1]
354 - Rookery Bay National Estuarine Research Reserve System-Wide Monitoring Program[2]
509 - SERC Water Quality Monitoring Network[6]
572 - Rookery Bay National Estuarine Research Reserve Seagrass Monitoring[10]
4043 - RBNERR Fish Assessment[11]
5002 - Florida STORET / WIN[3]

Secchi Depth - Discrete

Seasonal Kendall-Tau Trend Analysis

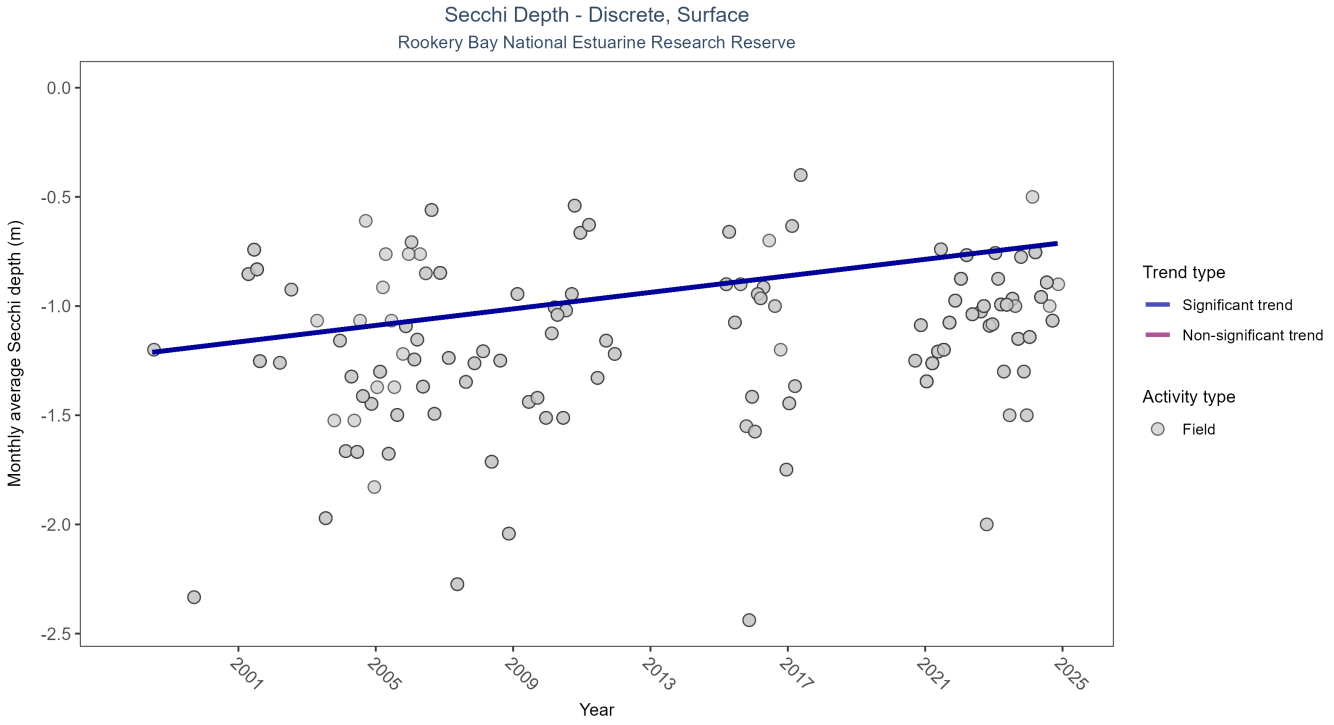

Figure 15: Scatter plot of monthly average Secchi depth over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Secchi depth is only measured in the field (circles).

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

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Field	Significantly increasing trend	768	21	1998 - 2024	-1.0668	0.2564	-1.221	0.0189	0.0002

Monthly average Secchi depth became shallower by 0.02 m per year, indicating a decrease in water clarity.

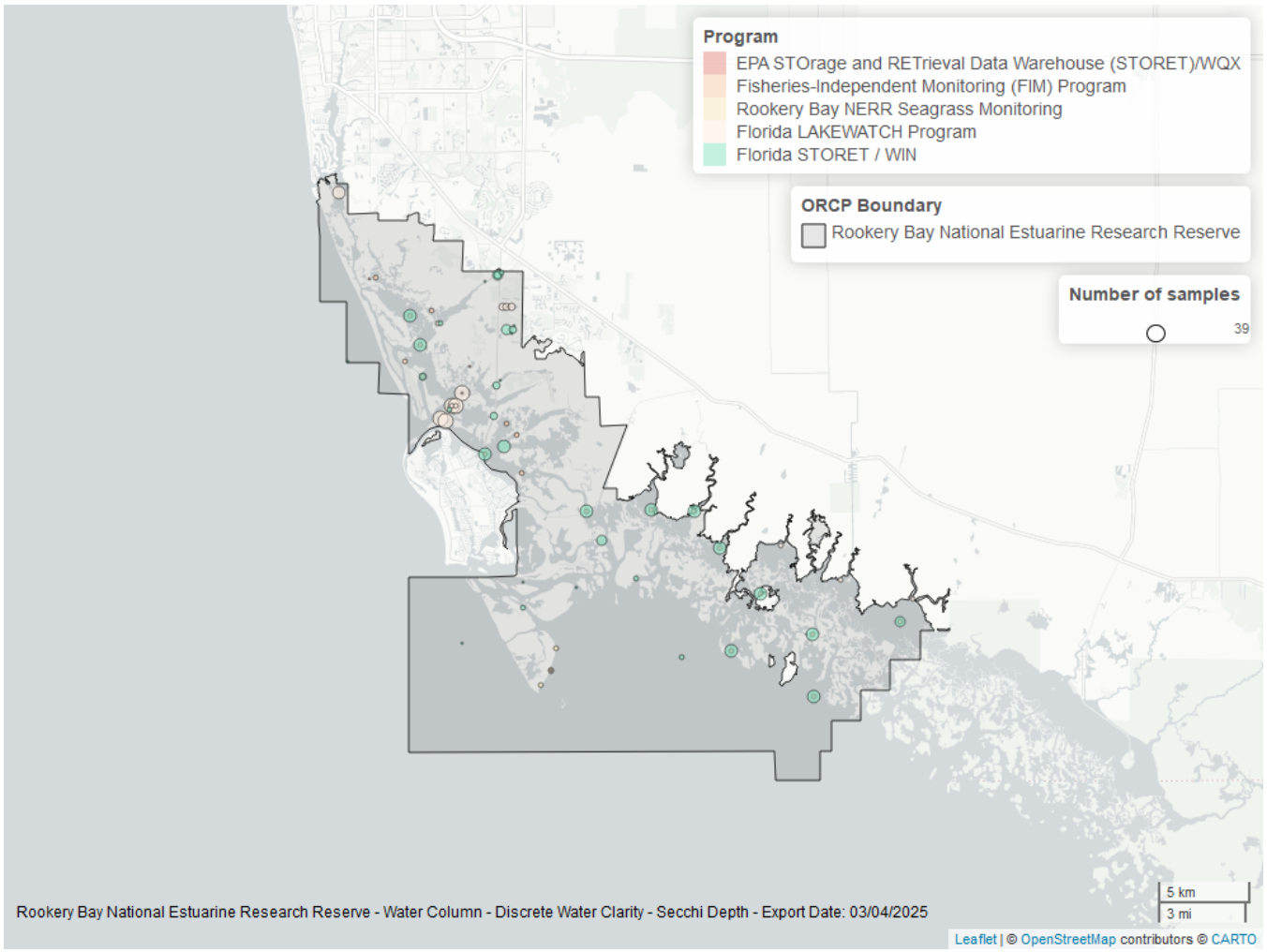

Figure 16: Map showing location of discrete water quality sampling locations within the boundaries of *Rookery Bay National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 21: Programs contributing data for Secchi Depth

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	409	2006	2024
514	252	2001	2017
103	76	2021	2021
69	22	2001	2001
572	9	1998	2003

Program names:

69 - Fisheries-Independent Monitoring (FIM) Program[8]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[4]
514 - Florida LAKEWATCH Program[7]
572 - Rookery Bay National Estuarine Research Reserve Seagrass Monitoring[10]
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

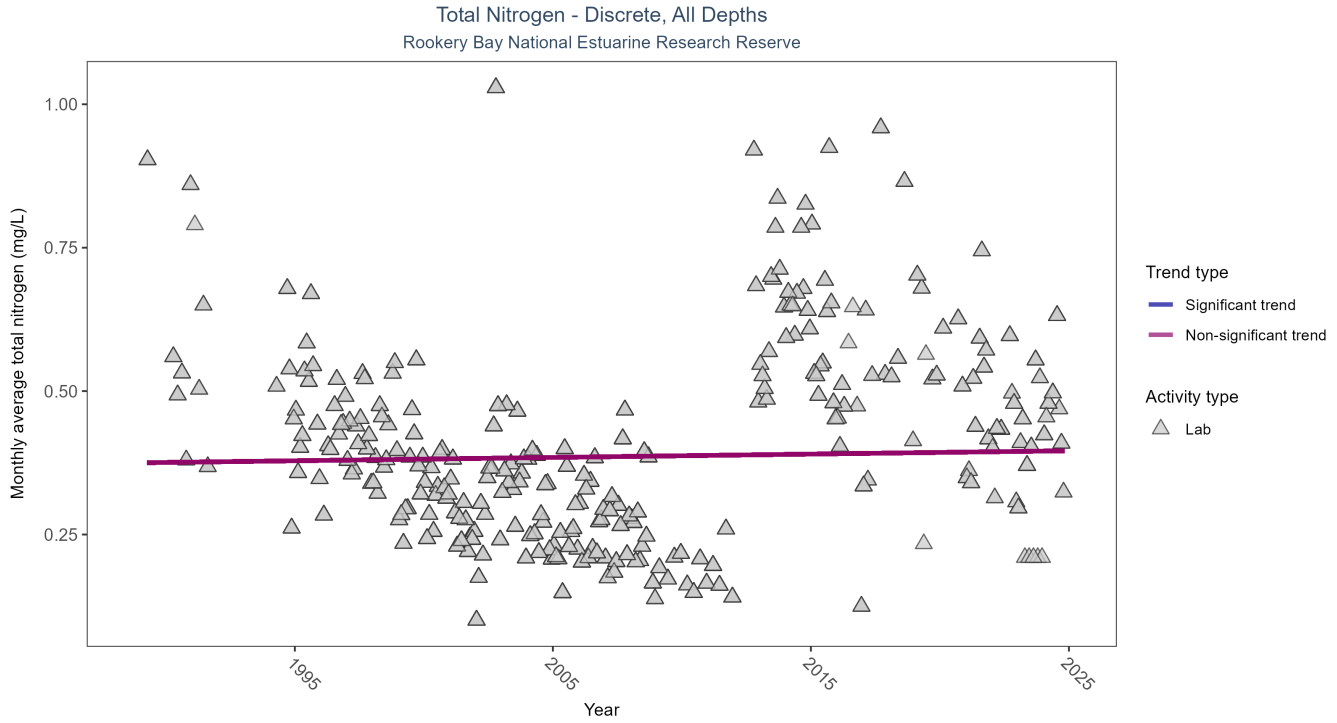

Figure 17: Scatter plot of monthly average total nitrogen over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only nitrogen values obtained from laboratory analyses (triangles) are included in the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

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

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Lab	No significant trend	5321	34	1989 - 2024	0.3184	0.0176	0.3751	0.0006	0.7234

Total nitrogen showed no detectable trend between 1989 and 2024.

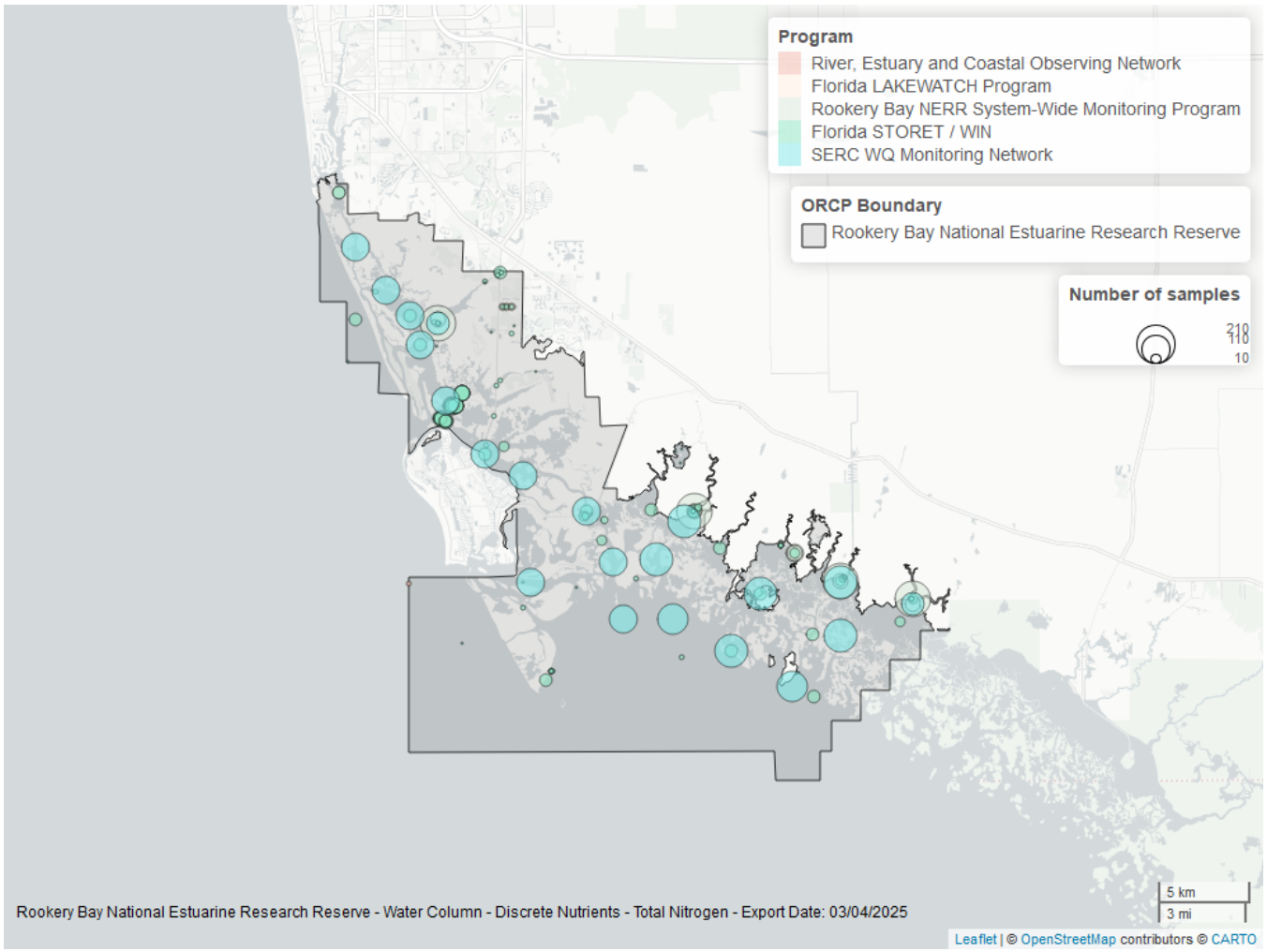

Figure 18: Map showing location of discrete water quality sampling locations within the boundaries of *Rookery Bay National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 23: Programs contributing data for Total Nitrogen

ProgramID	*N_Data*	*YearMin*	*YearMax*
509	2758	1994	2008
5002	1135	1989	2024
354	1051	2002	2018
514	605	2001	2017
303	3	2022	2023

Program names:

303 - River, Estuary and Coastal Observing Network[1]
354 - Rookery Bay National Estuarine Research Reserve System-Wide Monitoring Program[2]
509 - SERC Water Quality Monitoring Network[6]
514 - Florida LAKEWATCH Program[7]
5002 - Florida STORET / WIN[3]

Total Phosphorus - Discrete

Seasonal Kendall-Tau Trend Analysis

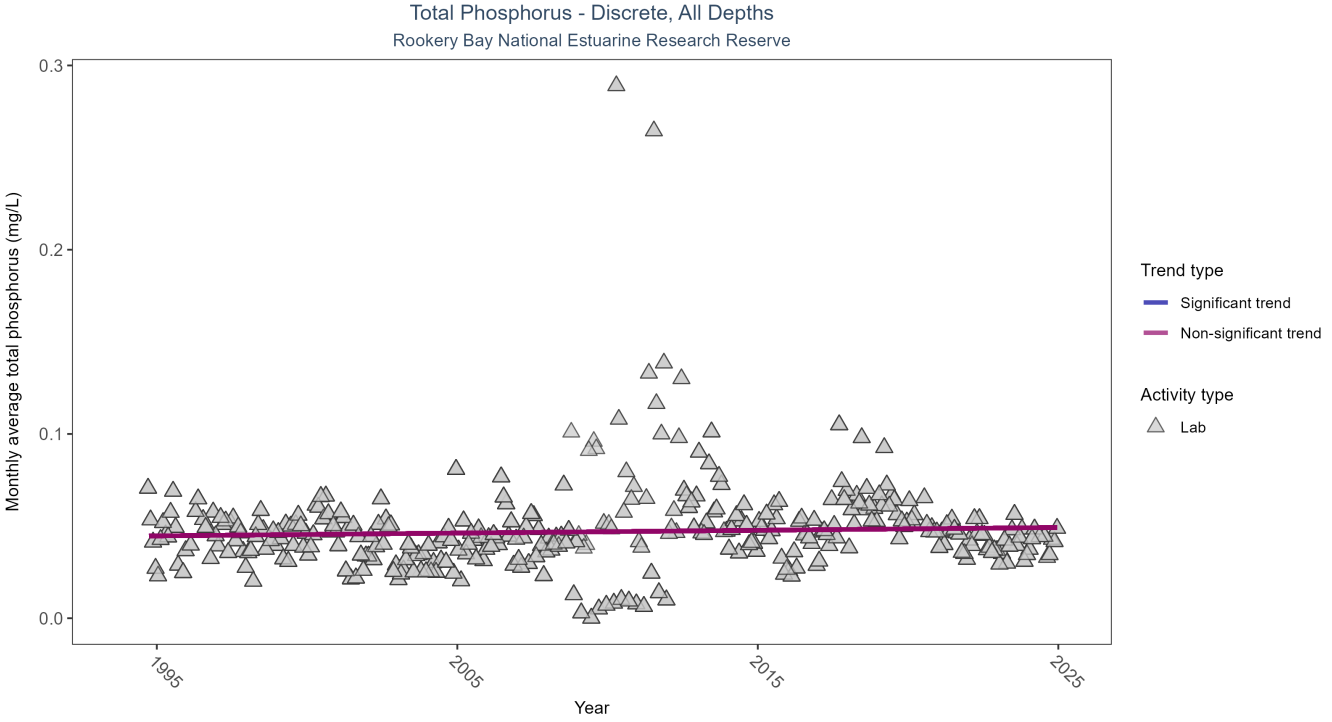

Figure 19: Scatter plot of monthly average total phosphorus over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only phosphorus values obtained from laboratory analyses (triangles) are included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

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

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Lab	No significant trend	5570	31	1994 - 2024	0.04	0.0728	0.0445	0.0001	0.0537

Total phosphorus showed no detectable trend between 1994 and 2024.

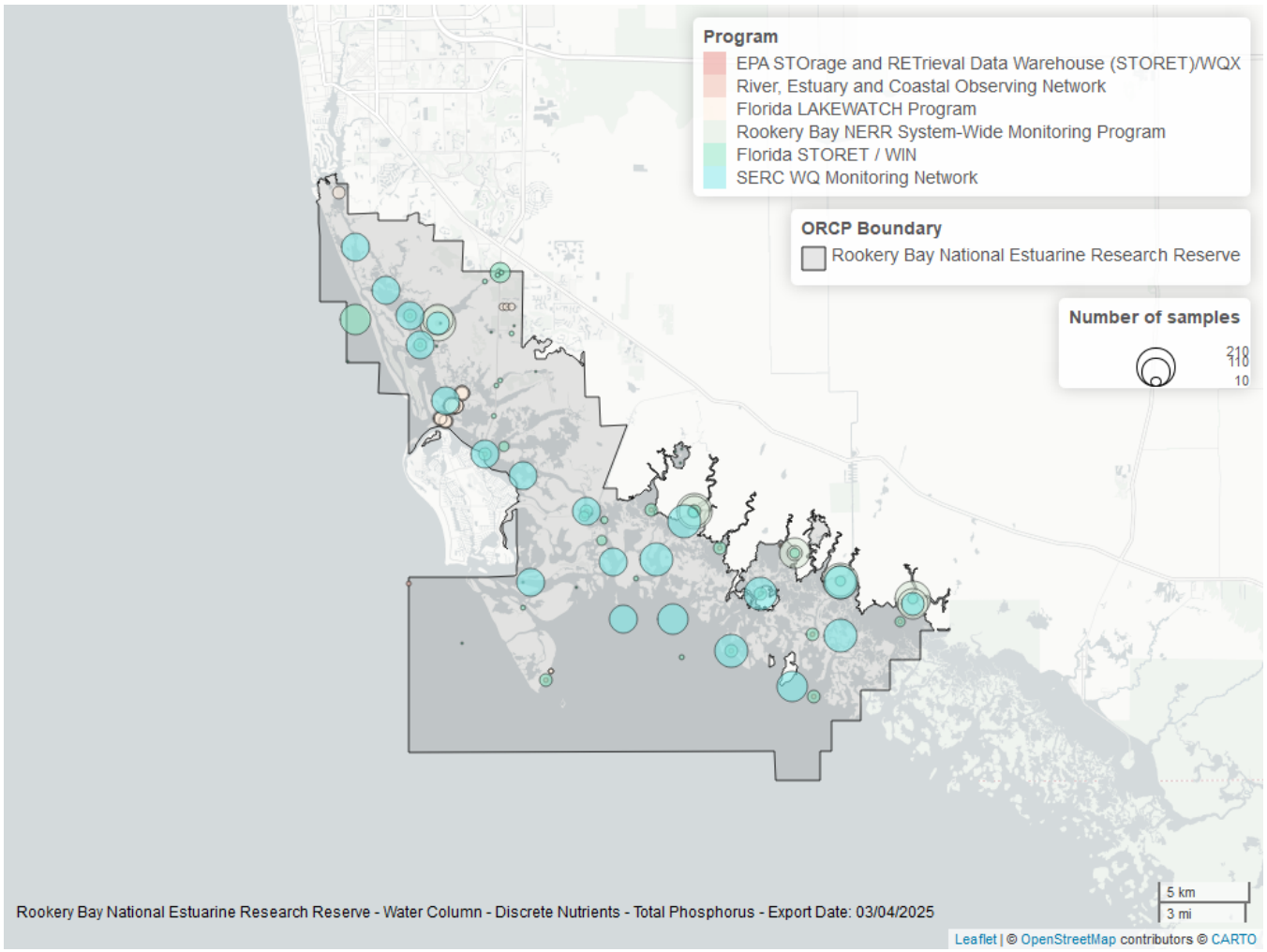

Figure 20: Map showing location of discrete water quality sampling locations within the boundaries of *Rookery Bay National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 25: Programs contributing data for Total Phosphorus

ProgramID	*N_Data*	*YearMin*	*YearMax*
509	2735	1994	2008
354	1507	2002	2024
5002	679	2001	2024
514	597	2001	2017
103	96	2021	2021
303	3	2022	2023

Program names:

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[4]
303 - River, Estuary and Coastal Observing Network[1]
354 - Rookery Bay National Estuarine Research Reserve System-Wide Monitoring Program[2]
509 - SERC Water Quality Monitoring Network[6]
514 - Florida LAKEWATCH Program[7]
5002 - Florida STORET / WIN[3]

Total Suspended Solids - Discrete

Seasonal Kendall-Tau Trend Analysis

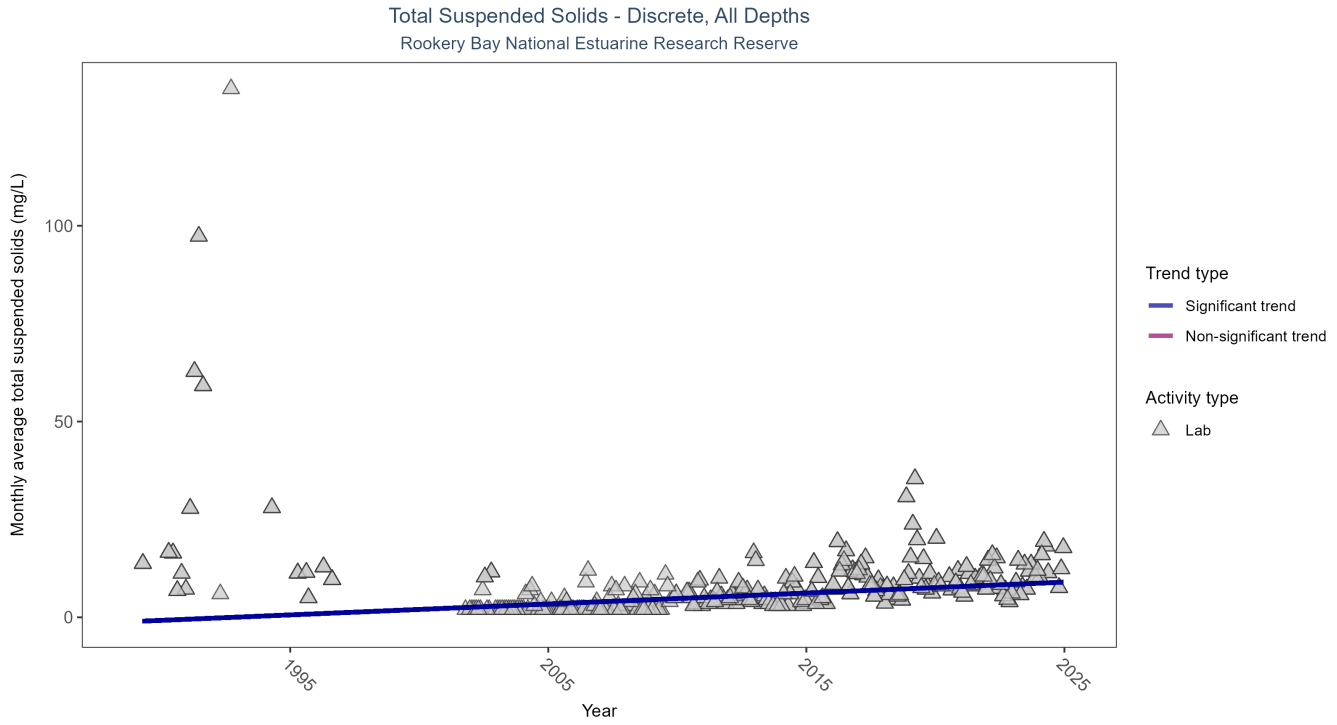

Figure 21: Scatter plot of monthly average total suspended solids (TSS) over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only TSS values obtained from laboratory analyses (triangles) are included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

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

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Lab	Significantly increasing trend	861	31	1989 - 2024	8	0.3785	-1.0549	0.2789	0

Monthly average total suspended solids increased by 0.28 mg/L per year, indicating a decrease in water clarity.

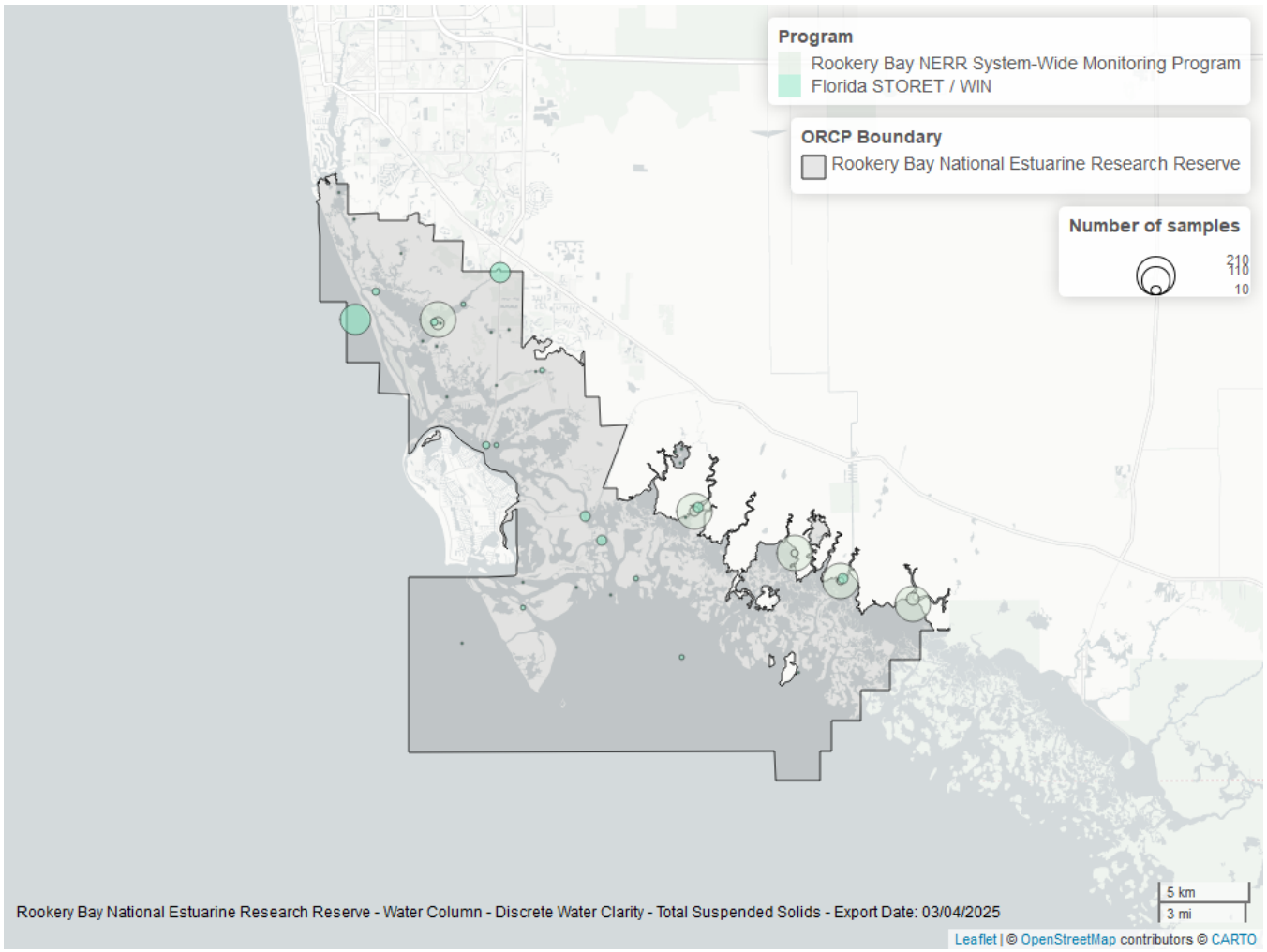

Figure 22: Map showing location of discrete water quality sampling locations within the boundaries of *Rookery Bay National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 27: Programs contributing data for Total Suspended Solids

ProgramID	*N_Data*	*YearMin*	*YearMax*
354	1085	2016	2024
5002	359	1989	2017

Program names:

354 - Rookery Bay National Estuarine Research Reserve System-Wide Monitoring Program[2]
5002 - Florida STORET / WIN[3]

Turbidity - Discrete

Seasonal Kendall-Tau Trend Analysis

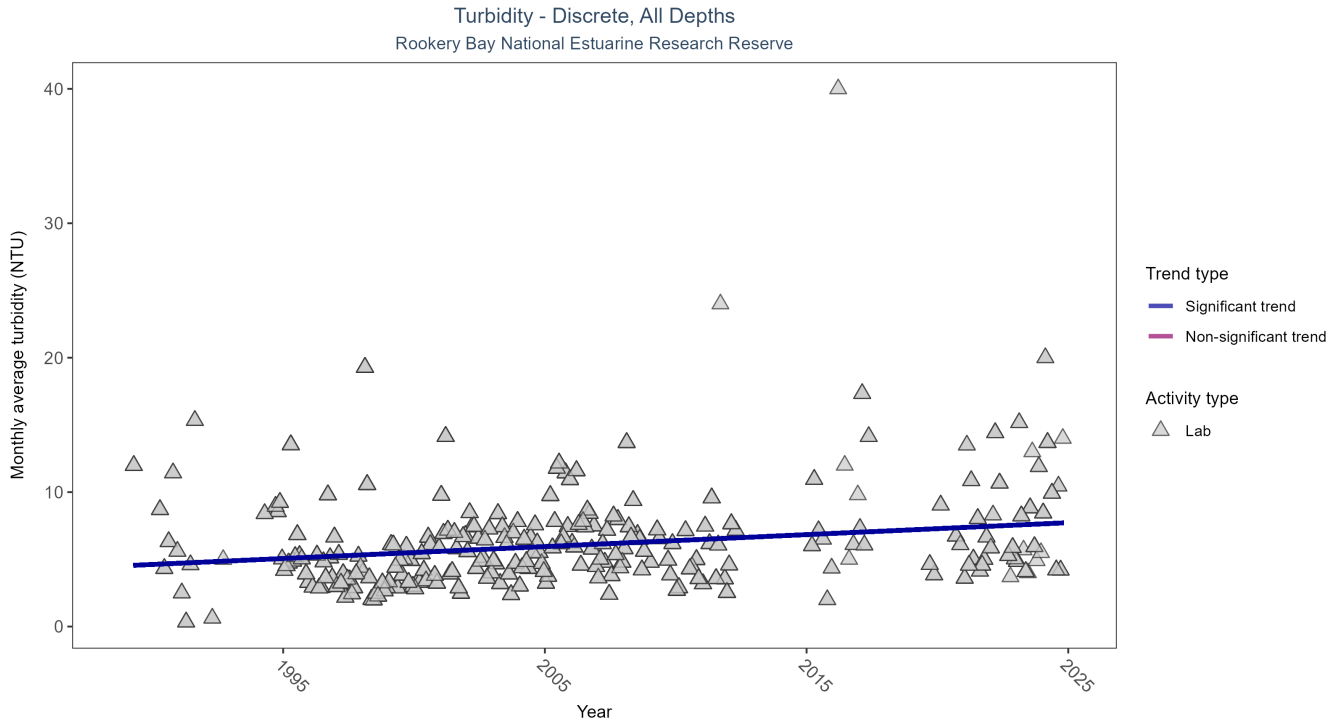

Figure 23: Scatter plot of monthly average turbidity over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only turbidity values measured in the laboratory (triangles) are included in the plot.

Table 28: Seasonal Kendall-Tau Trend Analysis for Turbidity

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Lab	Significantly increasing trend	6383	32	1989 - 2024	4.365	0.2084	4.5298	0.0888	0

Monthly average turbidity increased by 0.09 NTU per year, indicating a decrease in water clarity.

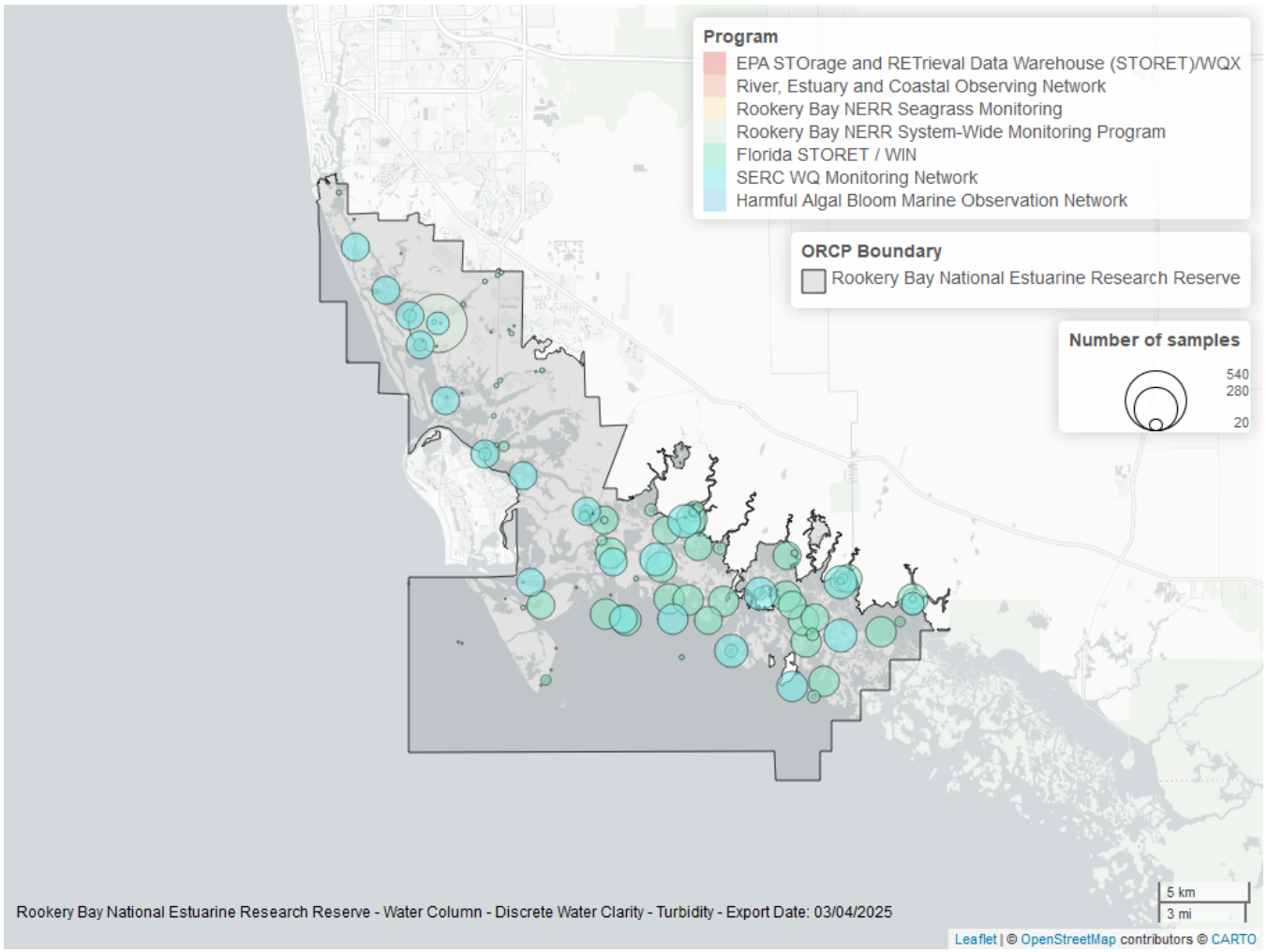

Figure 24: Map showing location of discrete water quality sampling locations within the boundaries of *Rookery Bay National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 29: Programs contributing data for Turbidity

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	3652	1989	2024
509	2746	1994	2008
354	734	2002	2006
103	92	2021	2021
572	4	2000	2003
95	3	2003	2011
303	1	2023	2023

Program names:

95 - Harmful Algal Bloom Marine Observation Network[9]
103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX[4]
303 - River, Estuary and Coastal Observing Network[1]
354 - Rookery Bay National Estuarine Research Reserve System-Wide Monitoring Program[2]
509 - SERC Water Quality Monitoring Network[6]

572 - Rookery Bay National Estuarine Research Reserve Seagrass Monitoring[10]
5002 - Florida STORET / WIN[3]

Water Temperature - Discrete

Seasonal Kendall-Tau Trend Analysis

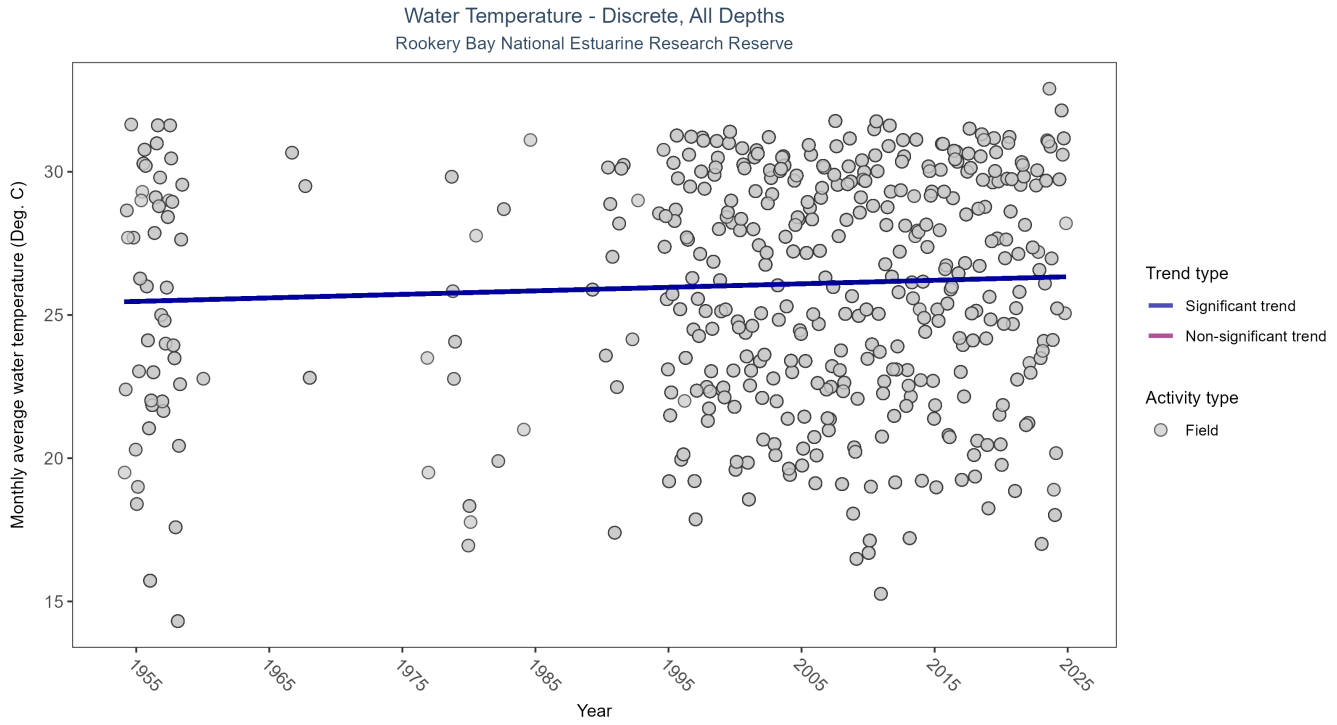

Figure 25: Scatter plot of monthly average water temperature over time. If the time series included ten or more years of discrete observations, a significant (blue) or non-significant (magenta) trend line is also shown. Only water temperature measurements taken in the field (circles) are included in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

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

Activity Type	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
Field	Significantly increasing trend	16851	50	1954 - 2024	26.65	0.1045	25.4611	0.0123	0.0018

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

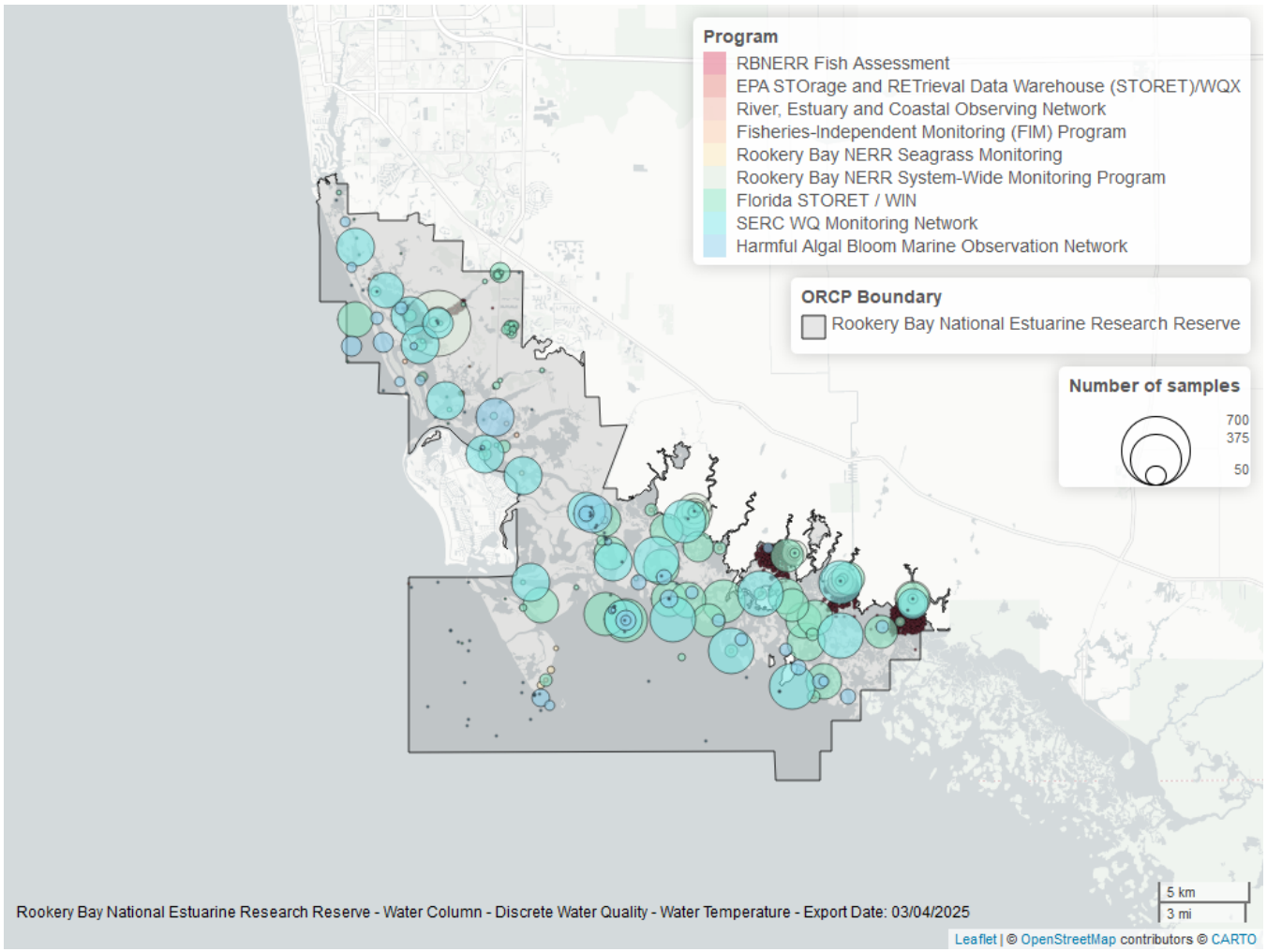

Figure 26: Map showing location of discrete water quality sampling locations within the boundaries of *Rookery Bay National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Table 31: Programs contributing data for Water Temperature

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	5654	1989	2024
509	5387	1994	2008
4043	3038	1999	2020
354	1806	2002	2024
95	1336	1954	2018
103	103	2021	2021
572	30	1998	2005
69	22	2001	2001
303	1	2023	2023

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]

303 - River, Estuary and Coastal Observing Network[1]
354 - Rookery Bay National Estuarine Research Reserve System-Wide Monitoring Program[2]
509 - SERC Water Quality Monitoring Network[6]
572 - Rookery Bay National Estuarine Research Reserve Seagrass Monitoring[10]
4043 - RBNERR Fish Assessment[11]
5002 - Florida STORET / WIN[3]

Water Quality - Continuous

The following files were used in the continuous analysis:

- *Combined_WQ_WC_NUT_cont_Dissolved_Oxygen_SW-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_cont_Dissolved_Oxygen_Saturation_SW-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_cont_pH_SW-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_cont_Salinity_SW-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_cont_Turbidity_SW-2025-Mar-06.txt*
- *Combined_WQ_WC_NUT_cont_Water_Temperature_SW-2025-Mar-06.txt*

Continuous monitoring locations in Rookery Bay National Estuarine Research Reserve

Table 32: Station overview for Continuous parameters by Program

ProgramID	*ProgramLocationID*	*Years of Data*	*Use in Analysis*	*Parameters*
7	02291330	4	FALSE	Sal , TempW
7	255123081321300	11	TRUE	Sal , TempW
7	255138081321701	9	TRUE	Sal , TempW
7	255432081303900	20	TRUE	Sal , TempW
7	255443081314700	5	FALSE	Sal , TempW
7	255532081314300	3	FALSE	Sal , TempW
7	255534081324000	19	TRUE	Sal , TempW
7	255654081350200	19	TRUE	Sal , TempW
7	255732081363700	5	TRUE	Sal , TempW
354	rkbbmwq	2	FALSE	DO , DOS , pH , Sal , Turb , TempW
354	rkbfbwq	24	TRUE	DO , DOS , pH , Sal , Turb , TempW
354	rkbfuwq	24	TRUE	DO , DOS , pH , Sal , Turb , TempW
354	rkblhwq	24	TRUE	DO , DOS , pH , Sal , Turb , TempW
354	rkbmbwq	25	TRUE	DO , DOS , pH , Sal , Turb , TempW
354	rkbpbwq	9	TRUE	DO , DOS , pH , Sal , Turb , TempW
354	rkbuhwq	5	TRUE	DO , DOS , pH , Sal , Turb , TempW

Program names:

7 - National Water Information System[12]
354 - Rookery Bay National Estuarine Research Reserve System-Wide Monitoring Program[2]

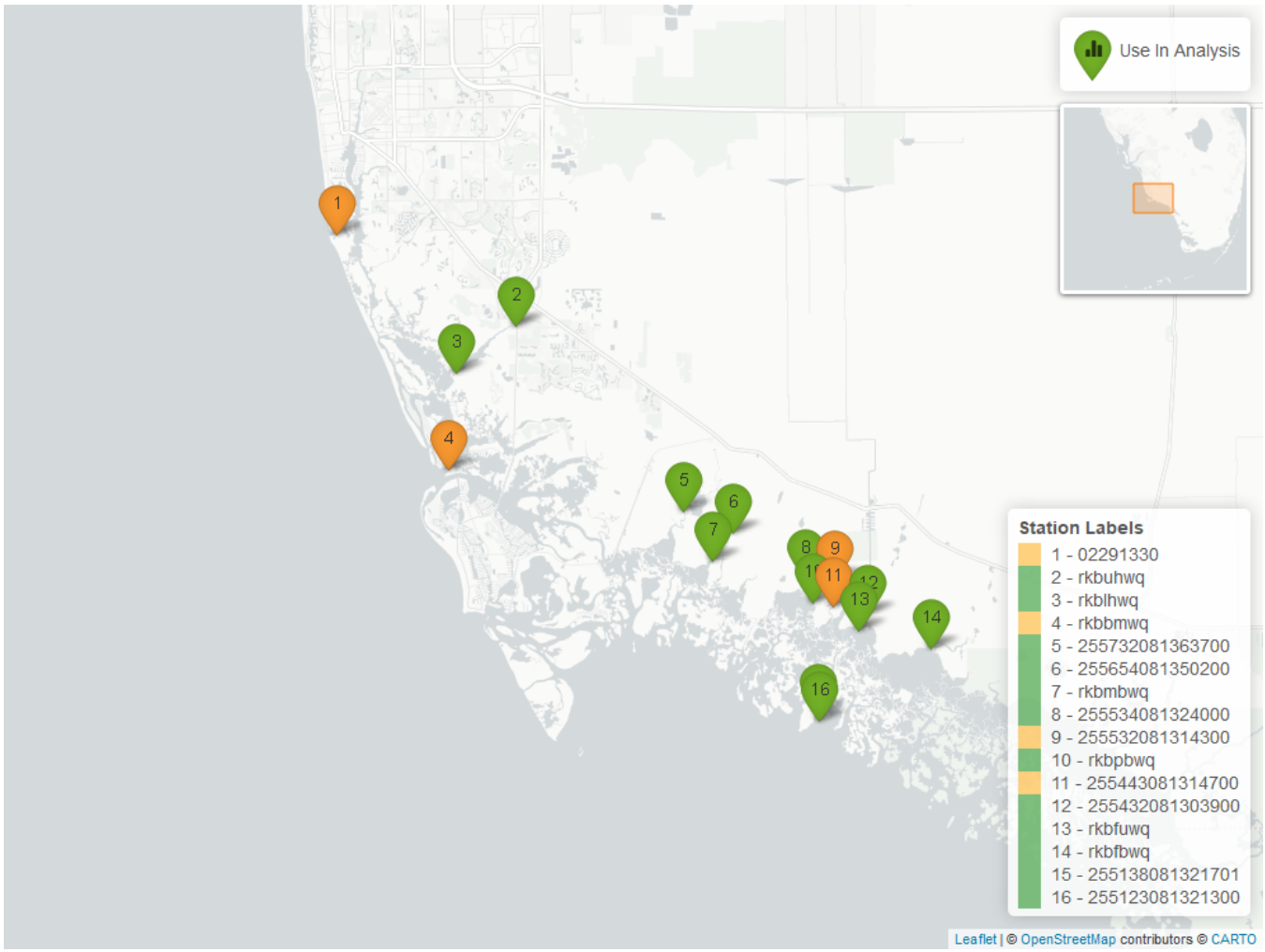

Figure 27: Map showing continuous water quality sampling locations within the boundaries of *Rookery Bay National Estuarine Research Reserve*. Sites marked as *Use In Analysis* (green) are featured in this report.

Dissolved Oxygen - Continuous

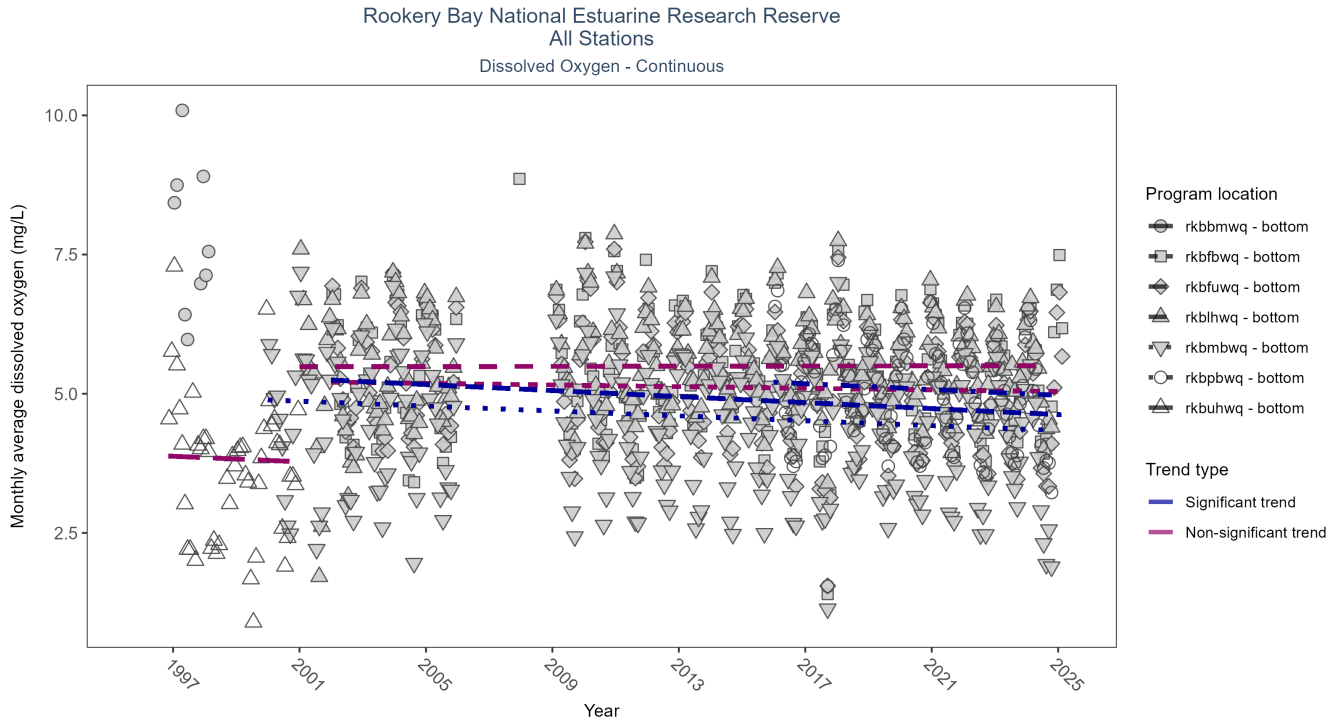

Figure 28: Scatter plot of monthly average dissolved oxygen over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 33: 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
rkbfbwq	No significant trend	570320	22	2002 - 2025	5.4	-0.06	5.21	-0.01	0.19
rkbfuwq	Significantly decreasing trend	605519	21	2002 - 2025	5.1	-0.32	5.25	-0.03	0
rkbbmwq	Insufficient data to calculate trend	10441	2	1997 - 1998	7.2	-	-	-	-
rkblhwq	No significant trend	570691	21	2001 - 2024	5.5	0	5.48	0	0.86
rkbmbwq	Significantly decreasing trend	613238	22	2000 - 2024	4.4	-0.26	4.89	-0.02	0
rkbpbwq	Significantly decreasing trend	289726	9	2016 - 2024	4.9	-0.18	5.21	-0.03	0.02
rkbuhwq	No significant trend	58164	5	1996 - 2000	3.6	0.01	3.9	-0.02	1

At three program locations, monthly average dissolved oxygen decreased between 0.02 and 0.03 mg/L per year. No detectable change in monthly average dissolved oxygen was observed at three locations. There was insufficient data to fit a model for one location.

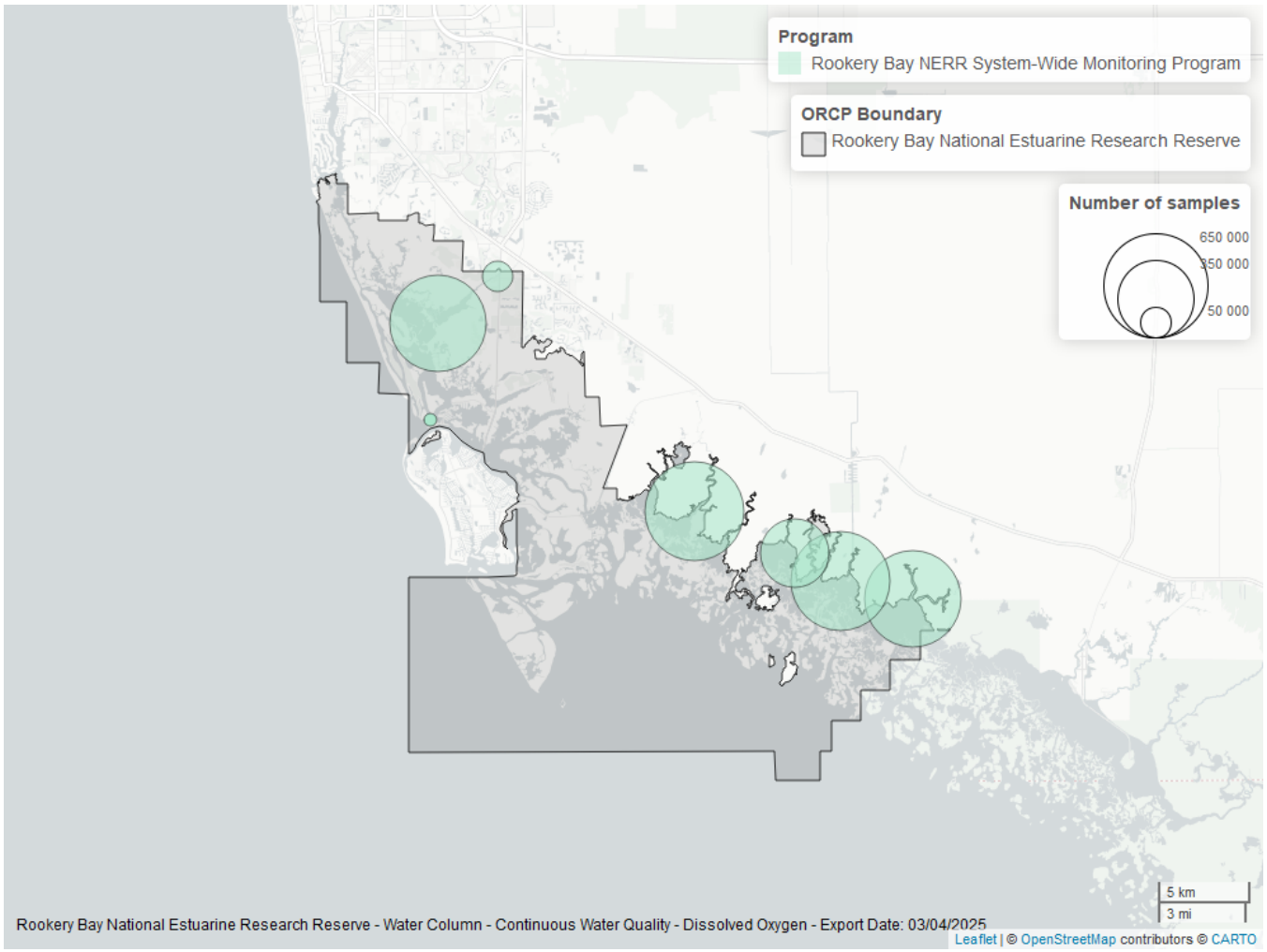

Figure 29: Map showing location of dissolved oxygen continuous water quality sampling locations within the boundaries of *Rookery Bay National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Dissolved Oxygen Saturation - Continuous

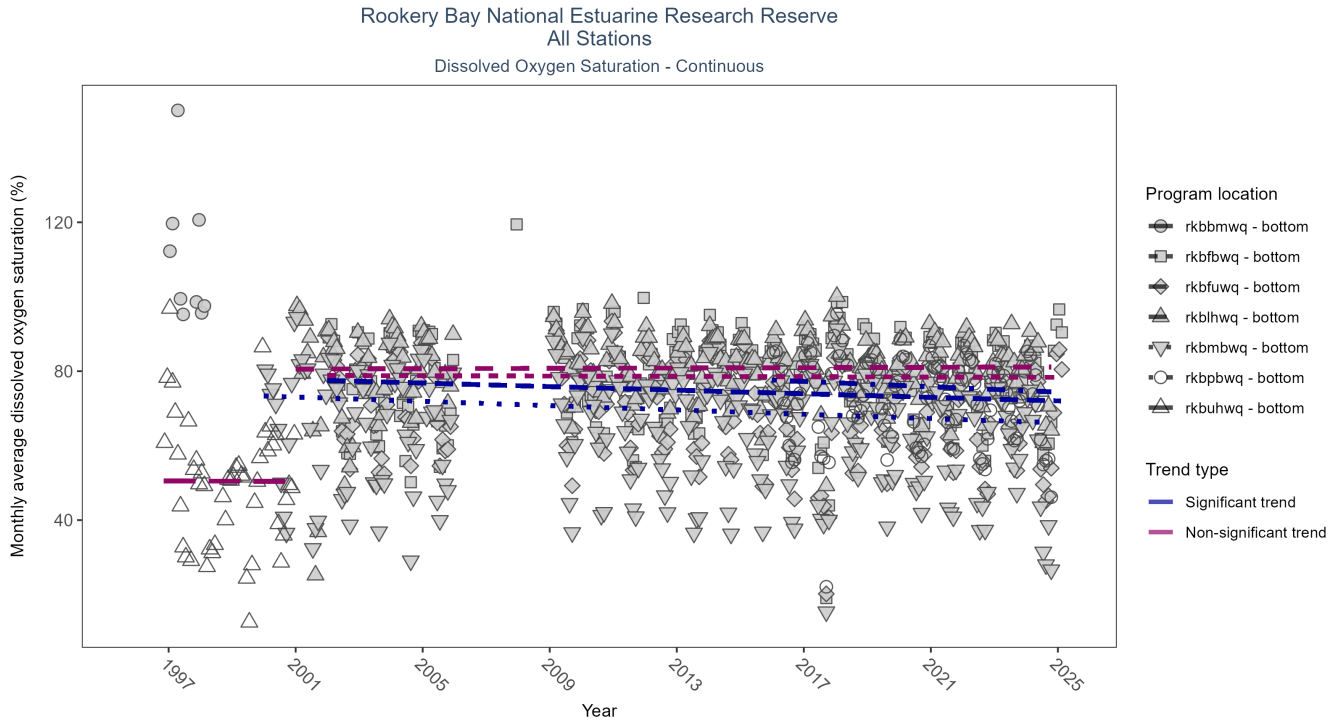

Figure 30: Scatter plot of monthly average dissolved oxygen saturation over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 34: 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
rkbfbwq	No significant trend	574626	22	2002 - 2025	78.7	-0.01	78.85	-0.02	0.79
rkbbmwq	Insufficient data to calculate trend	10441	2	1997 - 1998	102.4	-	-	-	-
rkbfuwq	Significantly decreasing trend	605778	21	2002 - 2025	72.4	-0.25	77.54	-0.24	0
rkblhwq	No significant trend	583009	21	2001 - 2024	81.7	0.02	80.58	0.02	0.55
rkbpbwq	Significantly decreasing trend	291357	9	2016 - 2024	72.3	-0.18	77.6	-0.36	0.03
rkbmbwq	Significantly decreasing trend	619562	22	2000 - 2024	65.1	-0.23	73.35	-0.29	0
rkbuhwq	No significant trend	58164	5	1996 - 2000	49.7	0	50.53	-0.02	1

At three program locations, monthly average dissolved oxygen saturation decreased between 0.24 and 0.36% per year. No detectable change in monthly average dissolved oxygen saturation was observed at three locations. There was insufficient data to fit a model for one location.

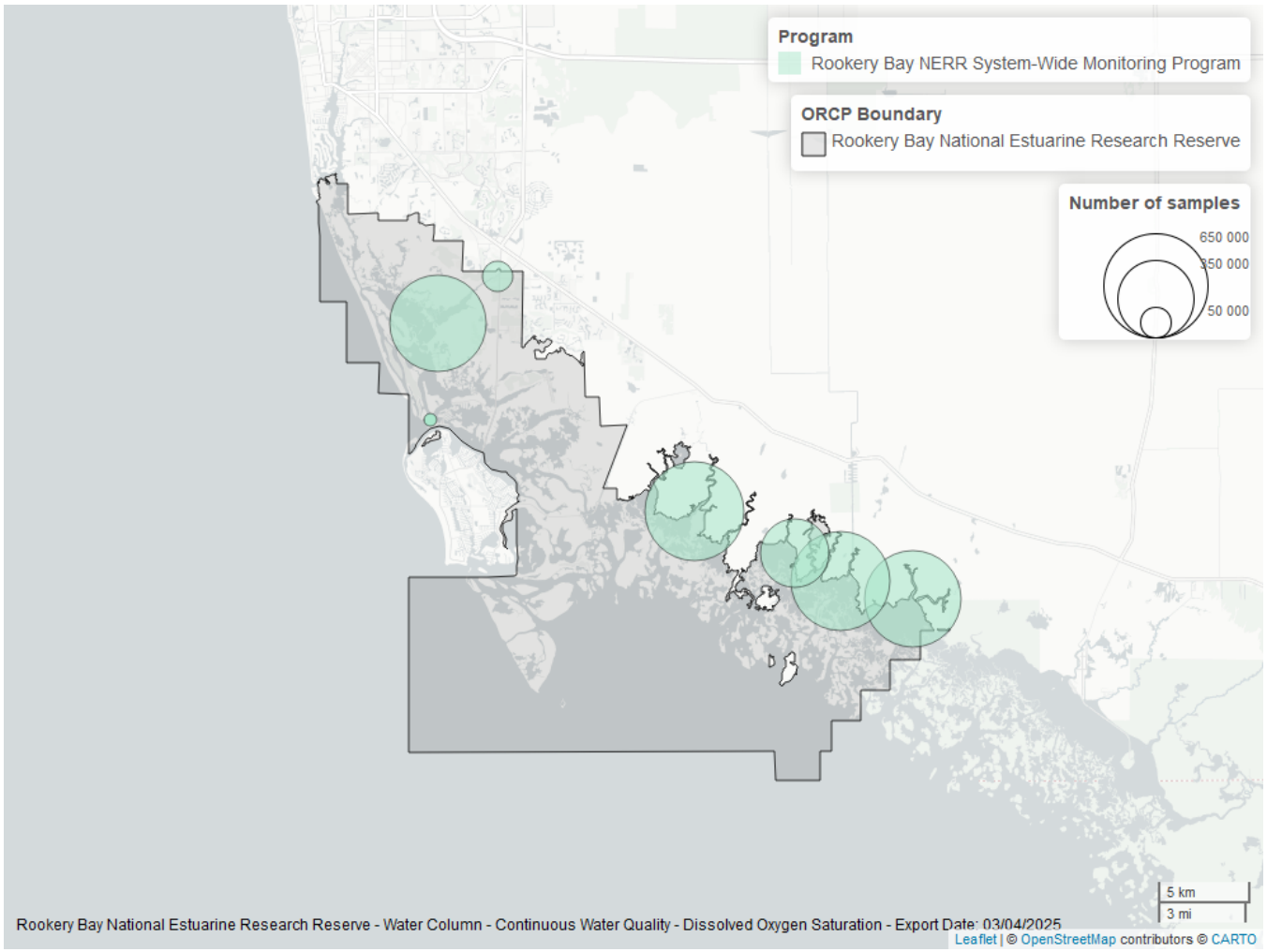

Figure 31: Map showing location of dissolved oxygen saturation continuous water quality sampling locations within the boundaries of *Rookery Bay National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

pH - Continuous

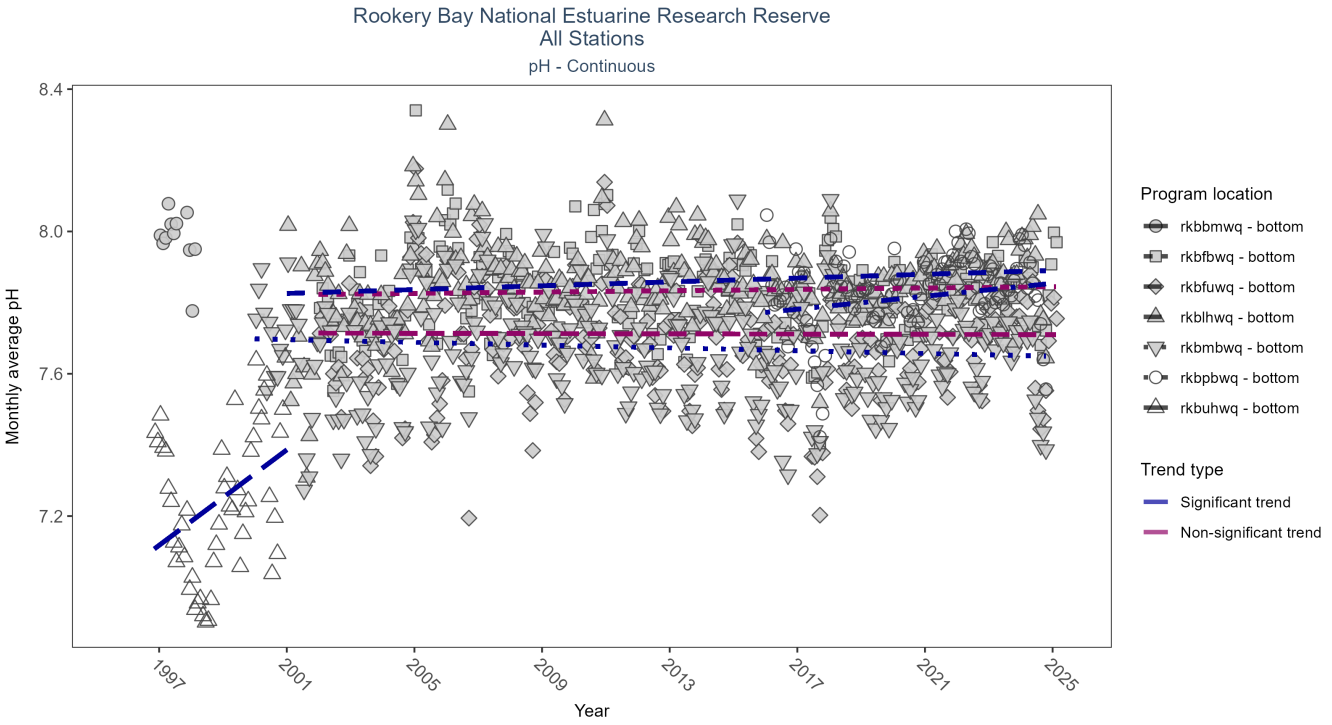

Figure 32: Scatter plot of monthly average pH over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 35: 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
rkbfbwq	No significant trend	637095	24	2002 - 2025	7.8	0.05	7.82	0	0.23
rkbbmwq	Insufficient data to calculate trend	12610	2	1997 - 1998	8.0	-	-	-	-
rkbfuwq	No significant trend	660818	24	2002 - 2025	7.7	-0.01	7.71	0	0.79
rkblhwq	Significantly increasing trend	629829	24	2001 - 2024	7.9	0.14	7.83	0	0
rkbmbwq	Significantly decreasing trend	683502	25	2000 - 2024	7.7	-0.09	7.7	0	0.03
rkbpbwq	Significantly increasing trend	283219	9	2016 - 2024	7.8	0.2	7.77	0.01	0.02
rkbuhwq	Significantly increasing trend	65814	5	1996 - 2000	7.2	0.37	7.05	0.07	0.01

At three program locations, monthly average pH increased between less than 0.01 and 0.07 pH units per year. At one program location, monthly average pH decreased by less than 0.01 pH units per year. No detectable change in monthly average pH was observed at two locations. There was insufficient data to fit a model for one location.

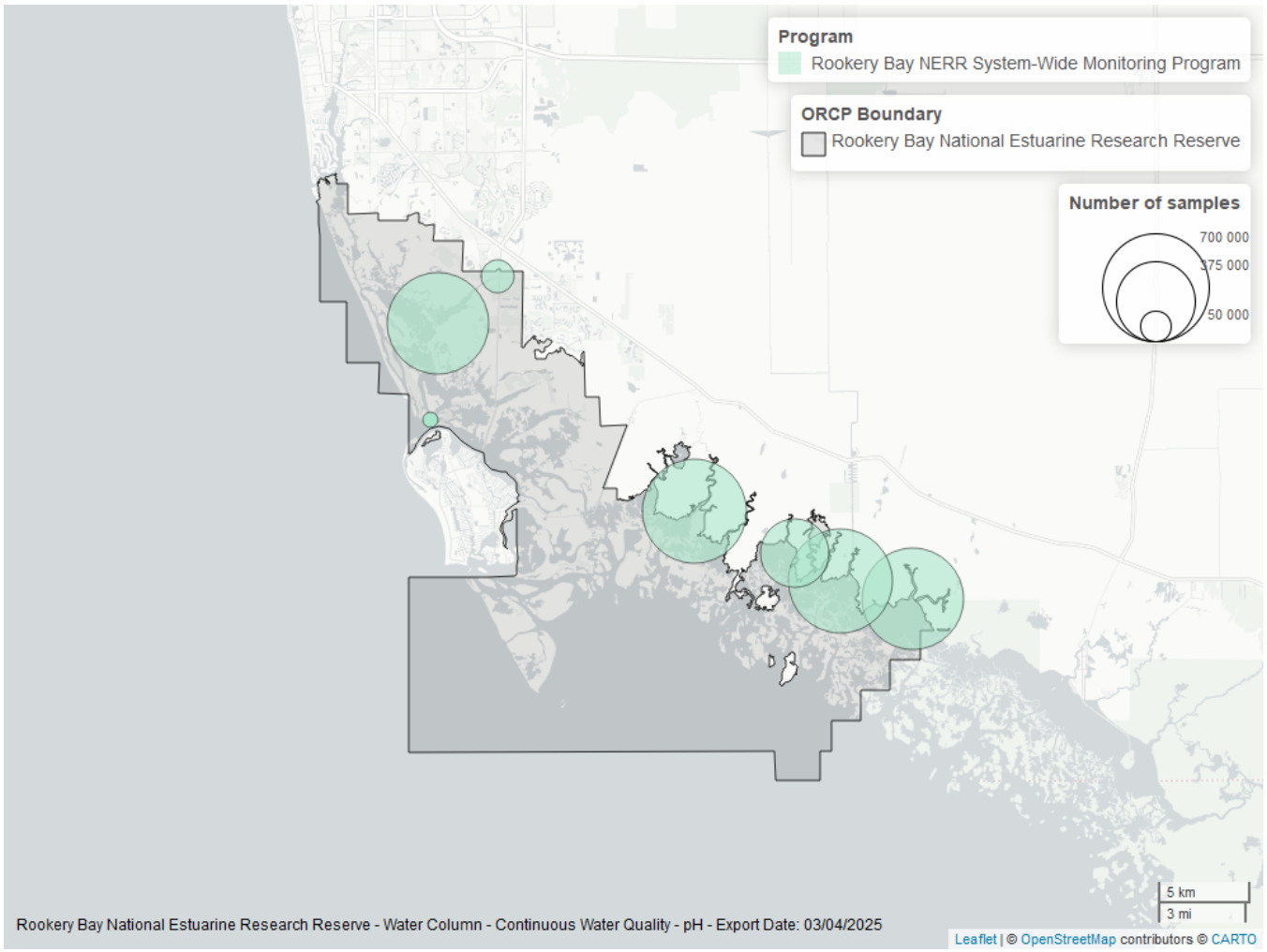

Figure 33: Map showing location of ph continuous water quality sampling locations within the boundaries of *Rookery Bay National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Salinity - Continuous - Program 7

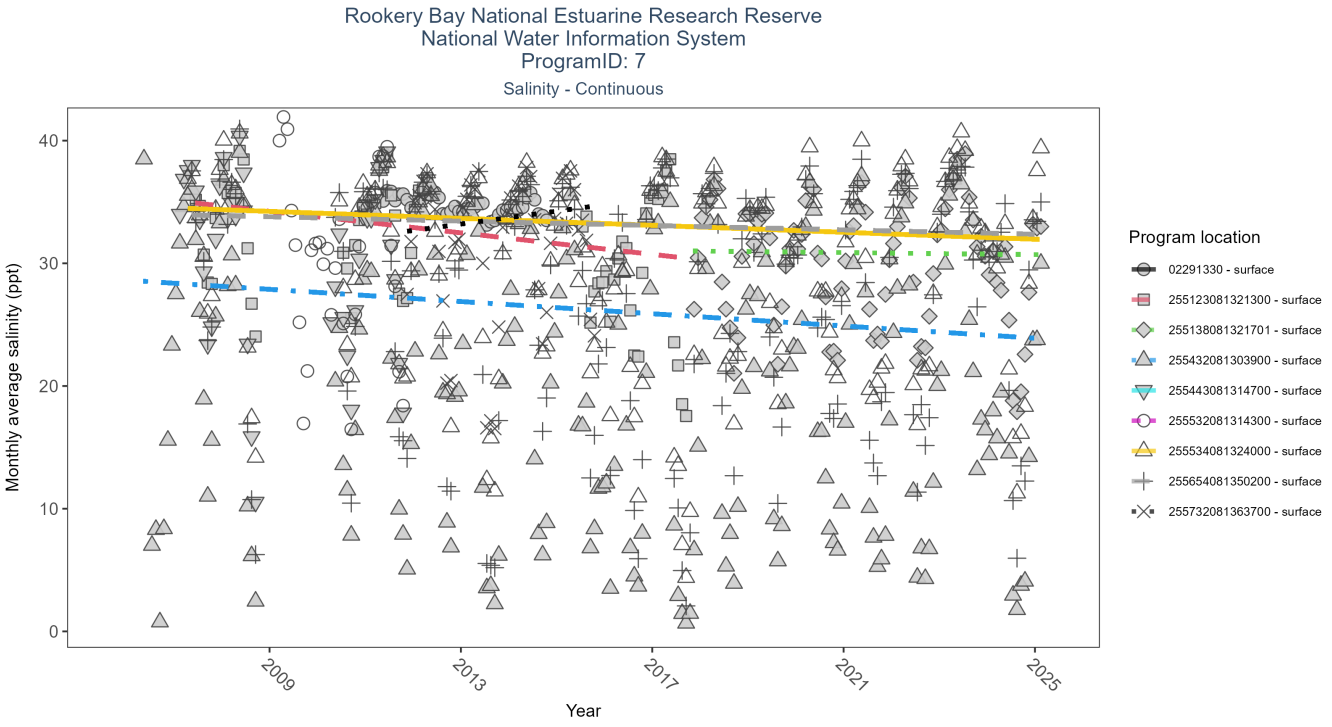

Figure 34: Scatter plot of monthly average salinity over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 36: Seasonal Kendall-Tau Results for Salinity - Program 7

Station	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
255532081314300	Insufficient data to calculate trend	902	3	2009 - 2011	31	-	-	-	-
255534081324000	Significantly decreasing trend	5789	18	2007 - 2025	32	-0.12	34.52	-0.14	0.02
255654081350200	No significant trend	5802	18	2007 - 2025	32	-0.09	33.97	-0.09	0.08
255732081363700	No significant trend	1434	5	2011 - 2015	34	0.25	32.15	0.52	0.1
02291330	Insufficient data to calculate trend	1697	4	2011 - 2014	35	-	-	-	-
255443081314700	Insufficient data to calculate trend	1465	4	2007 - 2011	32	-	-	-	-
255432081303900	Significantly decreasing trend	6087	19	2006 - 2025	21	-0.2	28.63	-0.25	0
255138081321701	No significant trend	2608	9	2017 - 2025	31	-0.04	31.04	-0.04	0.69
255123081321300	Significantly decreasing trend	1809	8	2007 - 2017	32	-0.23	35.11	-0.44	0.02

At one program location, monthly average salinity increased by 2.06 ppt per year. At five program locations, monthly average salinity decreased between 0.08 and 0.44 ppt per year. No detectable change in monthly average salinity was observed at six locations. There was insufficient data to fit a model for four locations.

Salinity - Continuous - Program 354

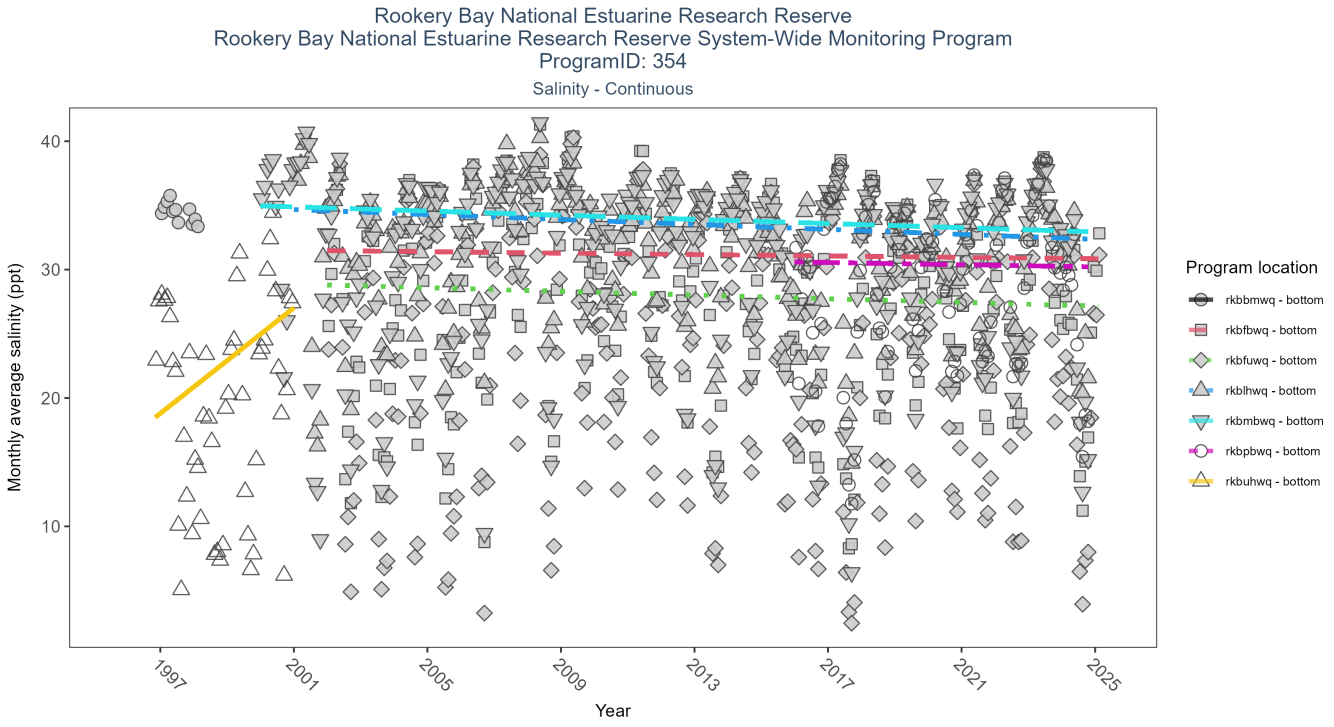

Figure 35: Scatter plot of monthly average salinity over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 37: Seasonal Kendall-Tau Results for Salinity - Program 354

Station	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
rkbfbwq	No significant trend	669593	24	2002 - 2025	29.6	-0.03	31.48	-0.03	0.47
rkbbmwq	Insufficient data to calculate trend	12256	2	1997 - 1998	34.5	-	-	-	-
rkbfuwq	No significant trend	686073	24	2002 - 2025	26.0	-0.06	28.81	-0.07	0.15
rkbmbwq	Significantly decreasing trend	694825	25	2000 - 2024	33.3	-0.12	34.97	-0.08	0
rkblhwq	Significantly decreasing trend	657842	24	2001 - 2024	33.1	-0.16	34.68	-0.1	0
rkbpbwq	No significant trend	290041	9	2016 - 2024	30.2	-0.01	30.6	-0.04	0.92
rkbuhwq	Significantly increasing trend	68446	5	1996 - 2000	21.1	0.31	16.74	2.06	0.04

At one program location, monthly average salinity increased by 2.06 ppt per year. At five program locations, monthly average salinity decreased between 0.08 and 0.44 ppt per year. No detectable change in monthly average salinity was observed at six locations. There was insufficient data to fit a model for four locations.

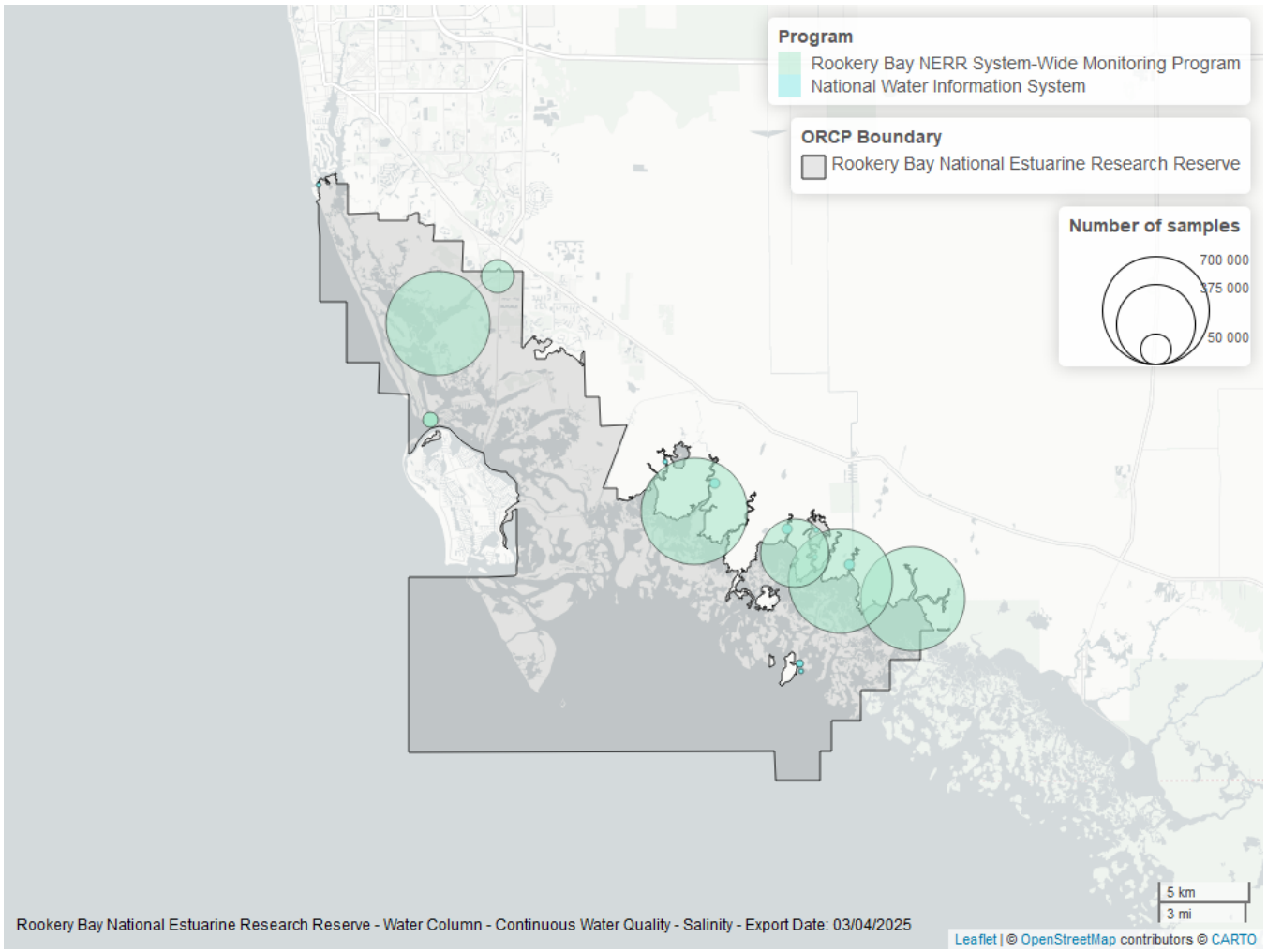

Figure 36: Map showing location of salinity continuous water quality sampling locations within the boundaries of *Rookery Bay National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Turbidity - Continuous

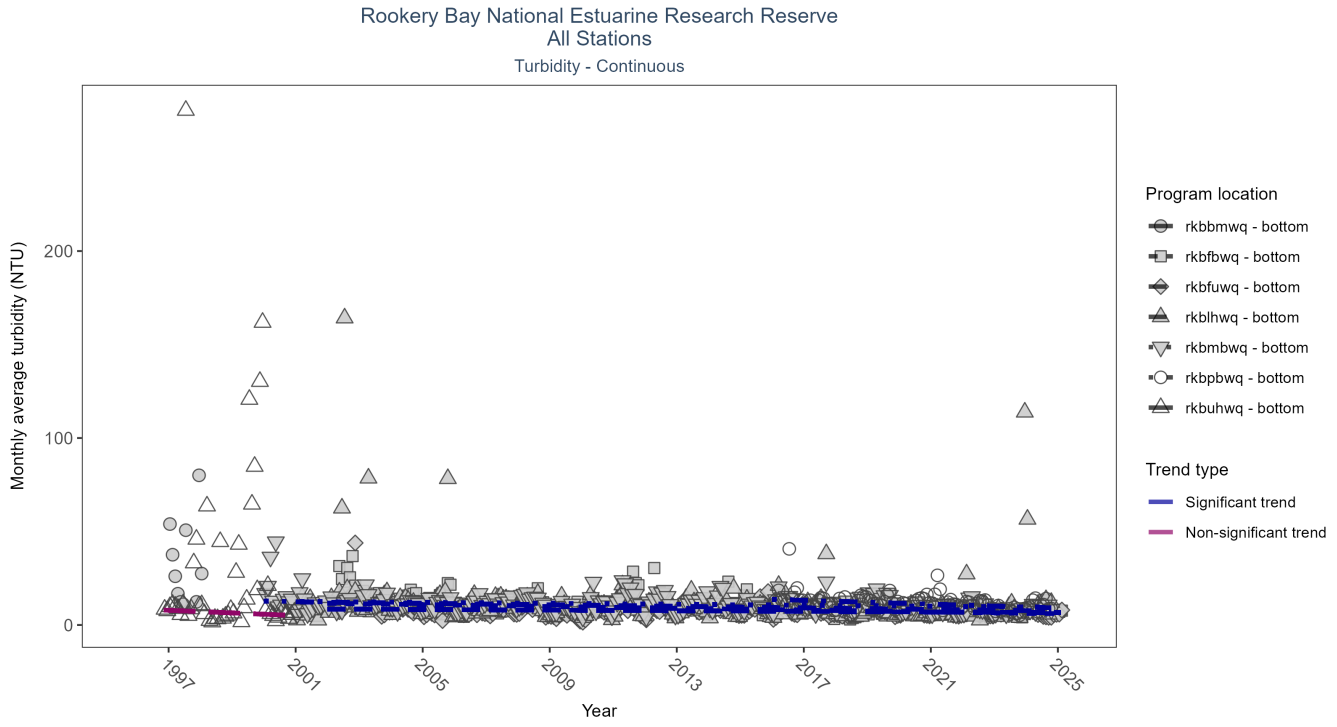

Figure 37: Scatter plot of monthly average turbidity over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 38: 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
rkbfbwq	Significantly decreasing trend	649336	24	2002 - 2025	7	-0.39	11.61	-0.24	0
rkbbmwq	Insufficient data to calculate trend	10654	2	1997 - 1998	11	-	-	-	-
rkbfuwq	Significantly decreasing trend	626788	24	2002 - 2025	6	-0.2	8.53	-0.08	0
rkblhwq	Significantly decreasing trend	605017	24	2001 - 2024	8	-0.27	12.4	-0.2	0
rkbmbwq	Significantly decreasing trend	670439	25	2000 - 2024	9	-0.22	12.74	-0.13	0
rkbpbwq	Significantly decreasing trend	286433	9	2016 - 2024	10	-0.37	13.71	-0.51	0
rkbuhwq	No significant trend	61608	5	1996 - 2000	5	-0.11	8.57	-0.7	0.52

At five program locations, monthly average turbidity decreased between 0.08 and 0.51 NTU per year. No detectable change in monthly average turbidity was observed at one location. There was insufficient data to fit a model for one location.

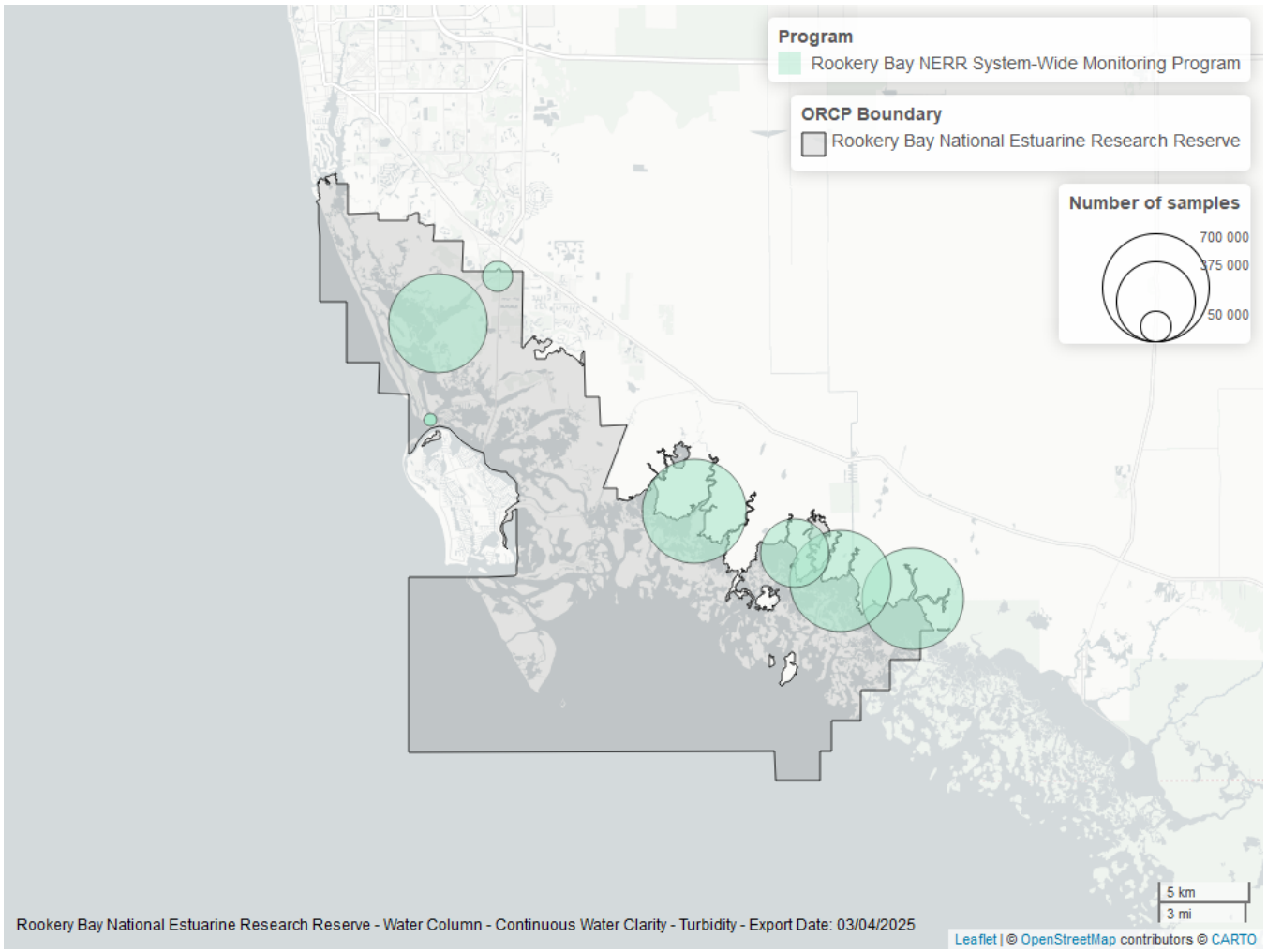

Figure 38: Map showing location of turbidity continuous water quality sampling locations within the boundaries of *Rookery Bay National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Water Temperature - Continuous - Program 7

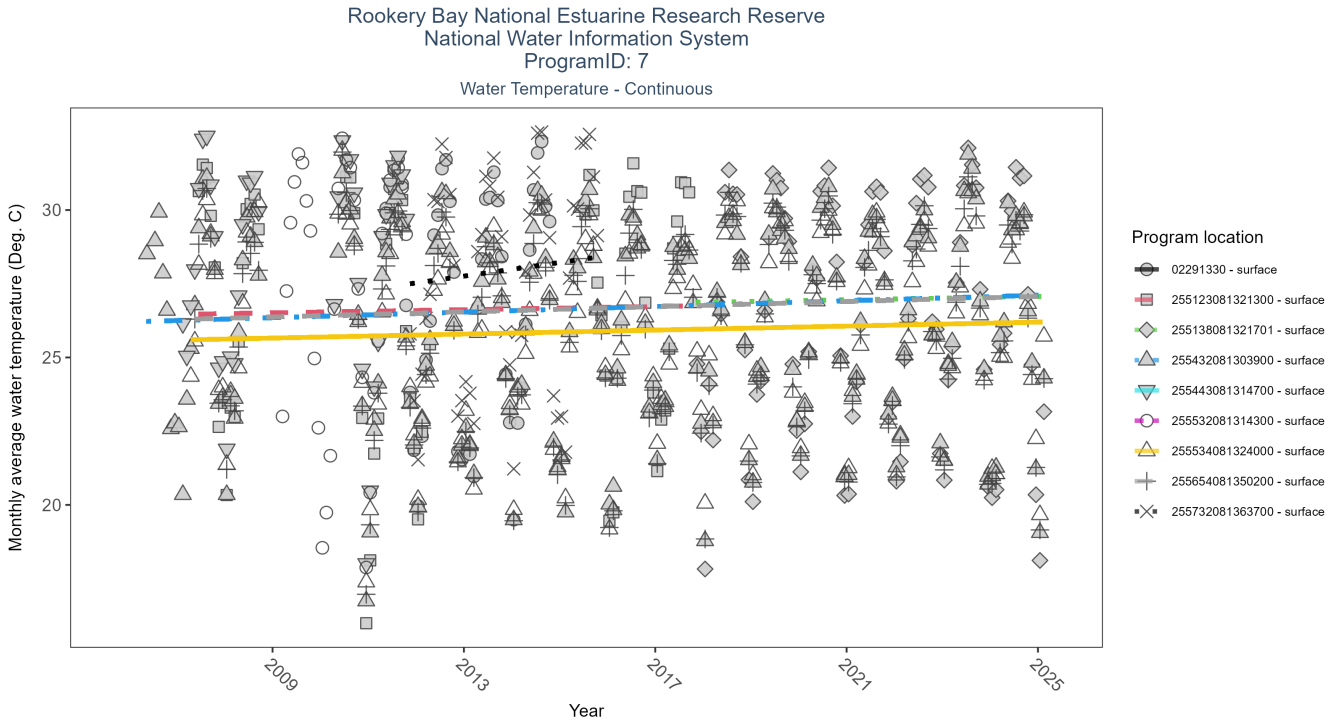

Figure 39: Scatter plot of monthly average water temperature over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 39: Seasonal Kendall-Tau Results for Water Temperature - Program 7

Station	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
255443081314700	Insufficient data to calculate trend	2011	4	2007 - 2011	29.30	-	-	-	-
255532081314300	Insufficient data to calculate trend	906	3	2009 - 2011	29.30	-	-	-	-
255534081324000	Significantly increasing trend	5845	18	2007 - 2025	26.60	0.14	25.59	0.03	0.01
255654081350200	Significantly increasing trend	5840	18	2007 - 2025	26.75	0.14	26.29	0.04	0.01
255732081363700	No significant trend	1435	5	2011 - 2015	28.40	0.24	27.3	0.23	0.11
02291330	Insufficient data to calculate trend	1901	4	2011 - 2014	28.30	-	-	-	-
255432081303900	Significantly increasing trend	6146	19	2006 - 2025	27.00	0.16	26.21	0.05	0
255123081321300	No significant trend	1818	8	2007 - 2017	27.30	0.1	26.46	0.03	0.38
255138081321701	No significant trend	2626	9	2017 - 2025	27.00	0.07	26.85	0.03	0.55

At seven program locations, monthly average water temperature increased between 0.03 and 0.07°C per year. No detectable change in monthly average water temperature was observed at five locations. There was insufficient data to fit a model for four locations.

Water Temperature - Continuous - Program 354

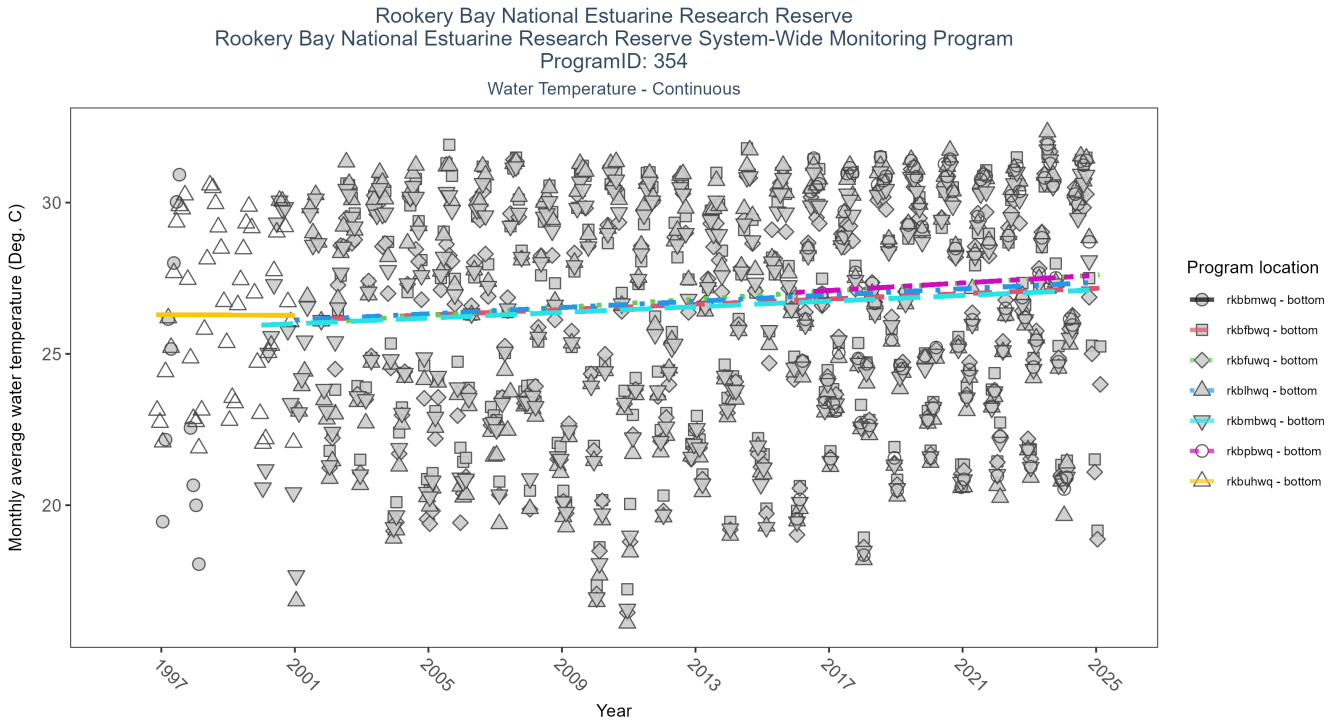

Figure 40: Scatter plot of monthly average water temperature over time at continuously monitored program locations. Each location is analyzed separately, with significant (blue) or non-significant (magenta) trend lines shown for time series that included five or more years of observations.

Table 40: Seasonal Kendall-Tau Results for Water Temperature - Program 354

Station	Statistical Trend	Sample Count	Years with Data	Period of Record	Median	tau	Sen Intercept	Sen Slope	p
rkbfbwq	Significantly increasing trend	685432	24	2002 - 2025	27.0	0.23	26.15	0.04	0
rkbbmwq	Insufficient data to calculate trend	12610	2	1997 - 1998	23.8	-	-	-	-
rkbfuwq	Significantly increasing trend	696504	24	2002 - 2025	26.9	0.26	26.07	0.07	0
rkblhwq	Significantly increasing trend	688994	24	2001 - 2024	27.0	0.25	26.12	0.05	0
rkbmbwq	Significantly increasing trend	718152	25	2000 - 2024	26.9	0.26	25.95	0.05	0
rkbpbwq	No significant trend	292925	9	2016 - 2024	27.6	0.14	27.03	0.06	0.07
rkbuhwq	No significant trend	68971	5	1996 - 2000	26.8	-0.01	26.3	-0.01	1

At seven program locations, monthly average water temperature increased between 0.03 and 0.07°C per year. No detectable change in monthly average water temperature was observed at five locations. There was insufficient data to fit a model for four locations.

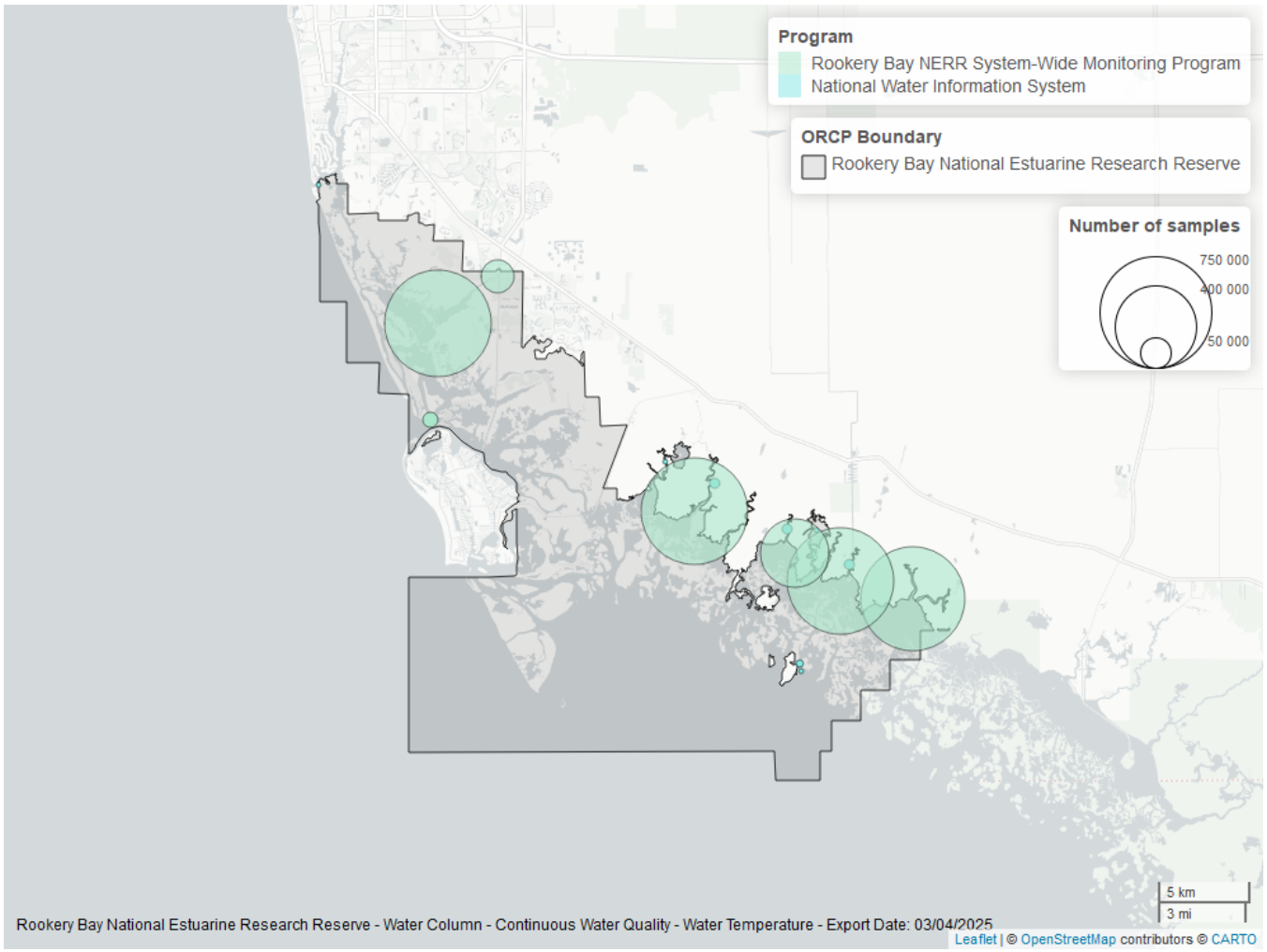

Figure 41: Map showing location of water temperature continuous water quality sampling locations within the boundaries of *Rookery Bay National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

Submerged Aquatic Vegetation

The data file used is: **All_SAV_Parameters-2025-Mar-06.txt**

Submerged aquatic vegetation (*SAV*) refers to plants and plant-like macroalgae species that live entirely underwater. The two primary categories of *SAV* inhabiting Florida estuaries are *benthic macroalgae* and *seagrasses*. They often grow together in dense beds or meadows that carpet the seafloor. *Macroalgae* include multicellular species of green, red and brown algae that often live attached to the substrate by a holdfast. They tend to grow quickly and can tolerate relatively high nutrient levels, making them a threat to seagrasses and other benthic habitats in areas with poor water quality. In contrast, *seagrasses* are grass-like, vascular, flowering plants that are attached to the seafloor by extensive root systems. *Seagrasses* occur throughout the coastal areas of Florida, including protected bays and lagoons as well as deeper offshore waters on the continental shelf. *Seagrasses* have taken advantage of the broad, shallow shelf and clear water to produce two of the most extensive seagrass beds anywhere in continental North America.

Parameters

Percent Cover measures the fraction of an area of seafloor that is covered by SAV, usually estimated by evaluating multiple small areas of seafloor. Percent cover is often estimated for total SAV, individual types of vegetation (seagrass, attached algae, drift algae) and individual species.

Frequency of Occurrence was calculated as the number of times a taxon was observed in a year divided by the number of sampling events, multiplied by 100. Analysis is conducted at the quadrat level and is inclusive of all quadrats (i.e., quadrats evaluated using Braun-Blanquet, modified Braun-Blanquet, and percent cover."

Species

Turtle grass (*Thalassia testudinum*) is the largest of the Florida seagrasses, with longer, thicker blades and deeper root structures than any of the other seagrasses. It is considered a climax seagrass species.

Shoal grass (*Halodule wrightii*) is an early colonizer of vegetated areas and usually grows in water too shallow for other species except *widgeon grass*. It can often tolerate larger salinity ranges than other seagrass species. *Shoal grass* is characterized by thin, flat blades, that are narrower than *turtle grass* blades.

Manatee grass (*Syringodium filiforme*) is easily recognizable because its leaves are thin and cylindrical instead of the flat, ribbon-like form shared by many other seagrass species. The leaves can grow up to half a meter in length. *Manatee grass* is usually found in mixed seagrass beds or small, dense monospecific patches.

Widgeon grass (*Ruppia maritima*) grows in both fresh and salt water and is widely distributed throughout Florida's estuaries in less saline areas, particularly in inlets along the east coast. This species resembles *shoal grass* in certain environments but can be identified by the pointed tips of its leaves.

Three species of *Halophila spp.* are found in Florida - **Star grass** (*Halophila engelmannii*), **Paddle grass** (*Halophila decipiens*), and **Johnson's seagrass** (*Halophila johnsonii*). These are smaller, more fragile seagrasses than other Florida species and are considered ephemeral. They grow along a single long rhizome, with short blades. These species are not well-studied, although surveys are underway to define their ecological roles.

Notes

Star grass, *Paddle grass*, and *Johnson's seagrass* will be grouped together and listed as **Halophila spp.** in the following managed areas. This is because several surveys did not specify to the species level:

- Banana River Aquatic Preserve
- Indian River-Malabar to Vero Beach Aquatic Preserve
- Indian River-Vero Beach to Ft. Pierce Aquatic Preserve
- Jensen Beach to Jupiter Inlet Aquatic Preserve
- Loxahatchee River-Lake Worth Creek Aquatic Preserve
- Mosquito Lagoon Aquatic Preserve

- Biscayne Bay Aquatic Preserve
- Florida Keys National Marine Sanctuary

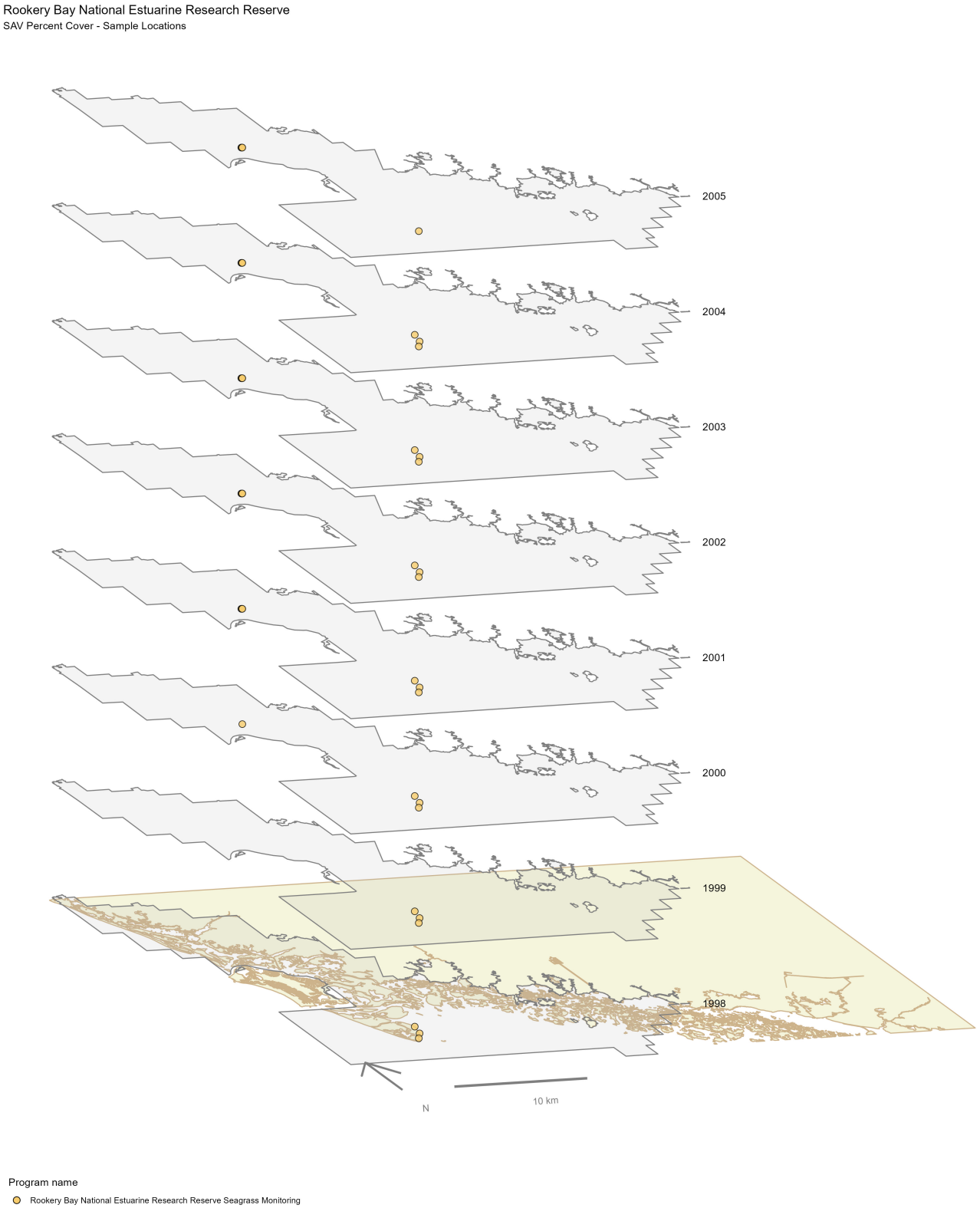

Figure 42: Maps showing the temporal scope of SAV sampling sites within the boundaries of *Rookery Bay National Estuarine Research Reserve* by Program name.

Click here to view spatio-temporal plots on GitHub.

Sampling locations by Program:

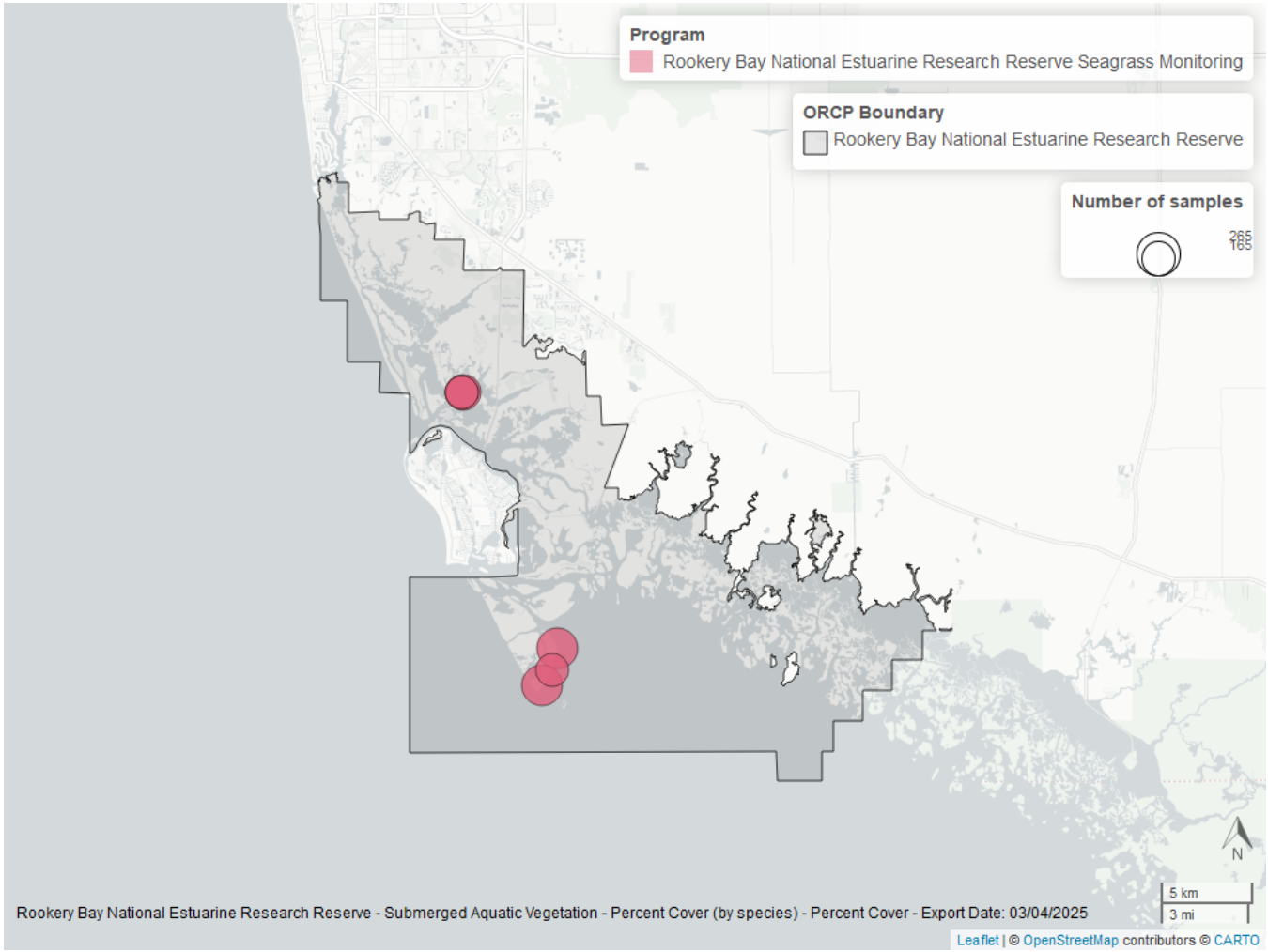

Figure 43: Map showing SAV sampling sites within the boundaries of *Rookery Bay National Estuarine Research Reserve*. The point size reflects the number of samples at a given sampling site.

Table 41: Program Information for Submerged Aquatic Vegetation

ProgramID	*N-Data*	*YearMin*	*YearMax*	*method*	*Sample Locations*
572	1220	1998	2005	Percent Cover	6

Program names:

572 - Rookery Bay National Estuarine Research Reserve Seagrass Monitoring[10]

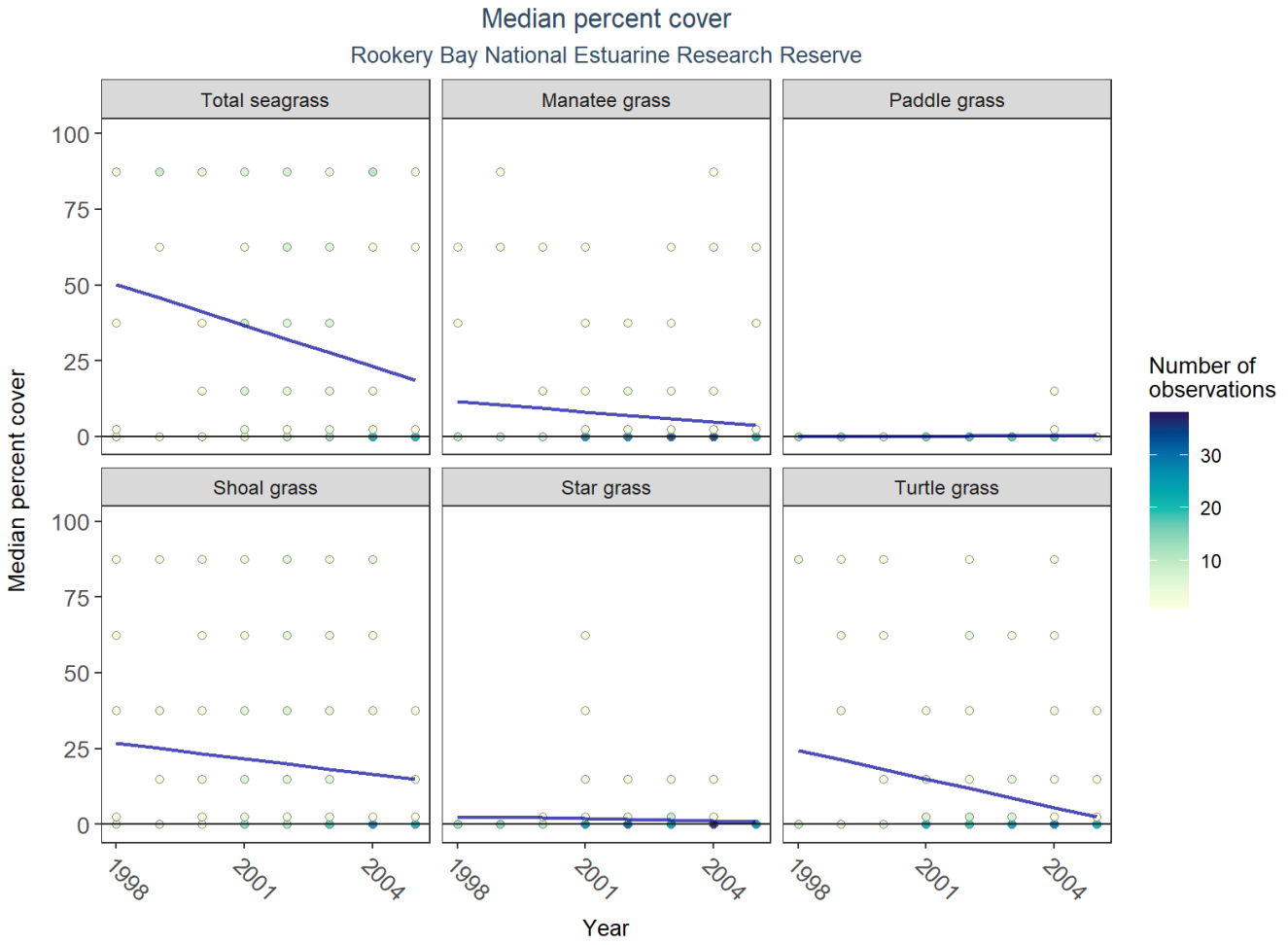

Figure 44: Scatter plots of median percent cover of submerged aquatic vegetation over time by group. Plots for time series that included five or more years of observations show the estimated trend as a blue line.

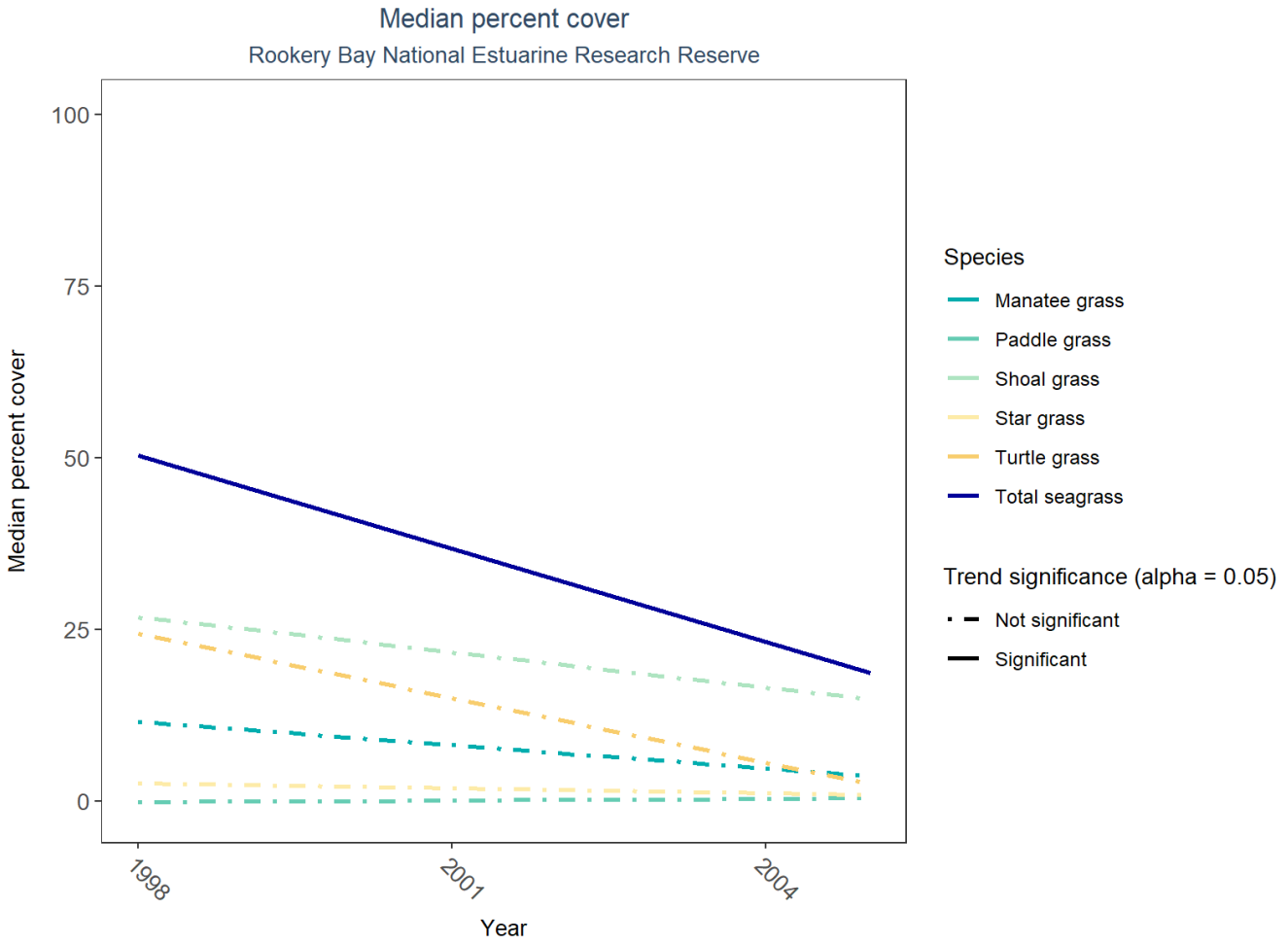

Figure 45: Trends in median percent cover for various seagrass species in Rookery Bay National Estuarine Research Reserve - simplified

Table 42: Percent Cover Trend Analysis for Rookery Bay National Estuarine Research Reserve

CommonName	*Trend Significance (0.05)*	*Period of Record*	*LME-Intercept*	*LME-Slope*	*p*
Shoal grass	No significant trend	1998 - 2005	33.6288441	-1.7091190	0.2546081
Paddle grass	No significant trend	1998 - 2005	-0.4445638	0.0784246	0.3562778
Star grass	No significant trend	1998 - 2005	3.5304862	-0.2323271	0.4437138
Manatee grass	No significant trend	1998 - 2005	16.1047980	-1.1343869	0.4000887
Turtle grass	No significant trend	1998 - 2005	36.9897733	-3.1381134	0.0666614
Total seagrass	Significantly decreasing trend	1998 - 2005	68.3694828	-4.5209704	0.0166198

An annual decrease in percent cover was observed for total seagrass (-4.5%). Manatee grass, paddle grass, shoal grass, star grass, and turtle grass showed no detectable change in percent cover.

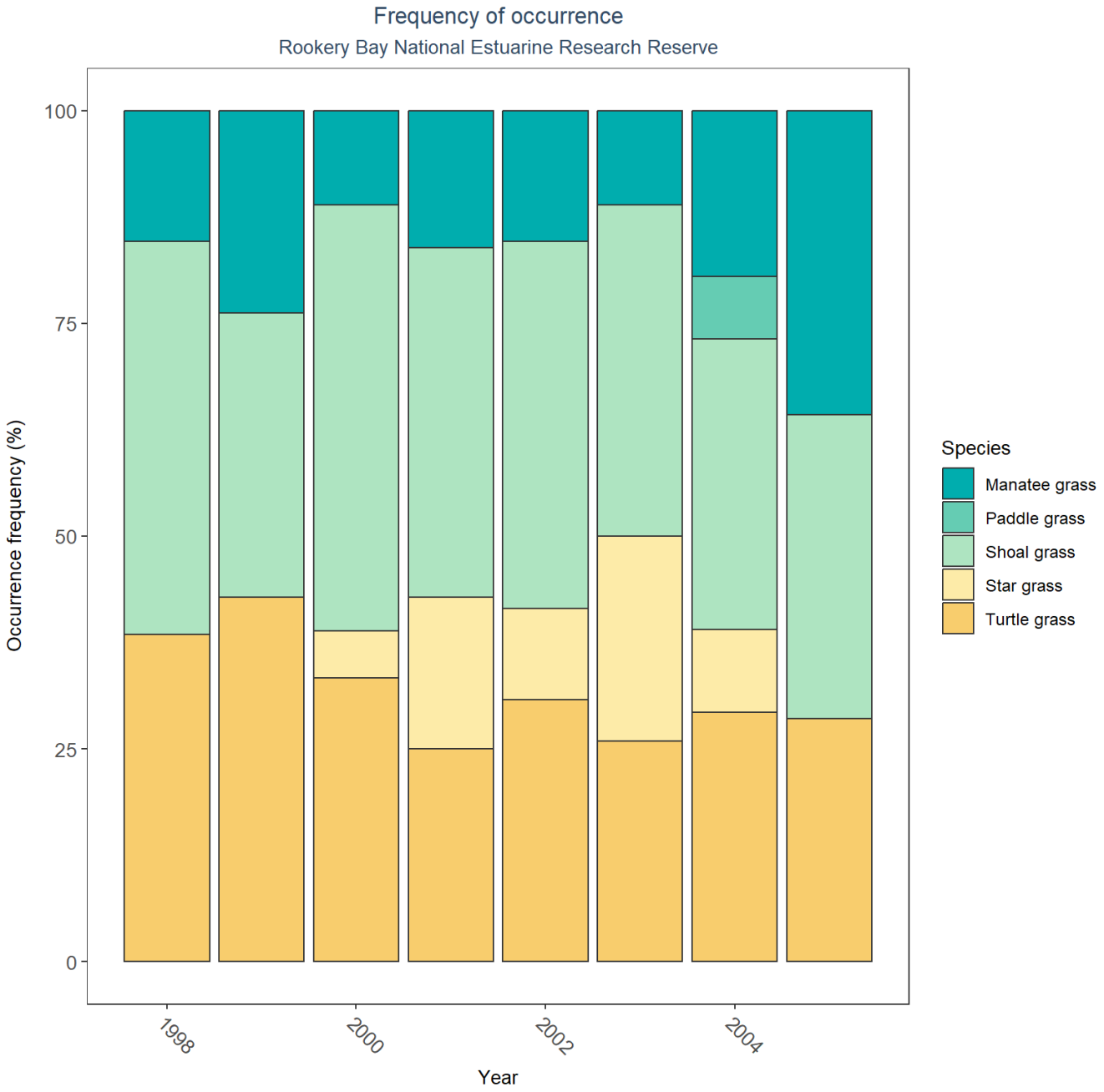

Figure 46: Frequency of occurrence for various seagrass species in Rookery Bay National Estuarine Research Reserve

Nekton

The data file used is: **All_NEKTON_Parameters-2025-Mar-06.txt**

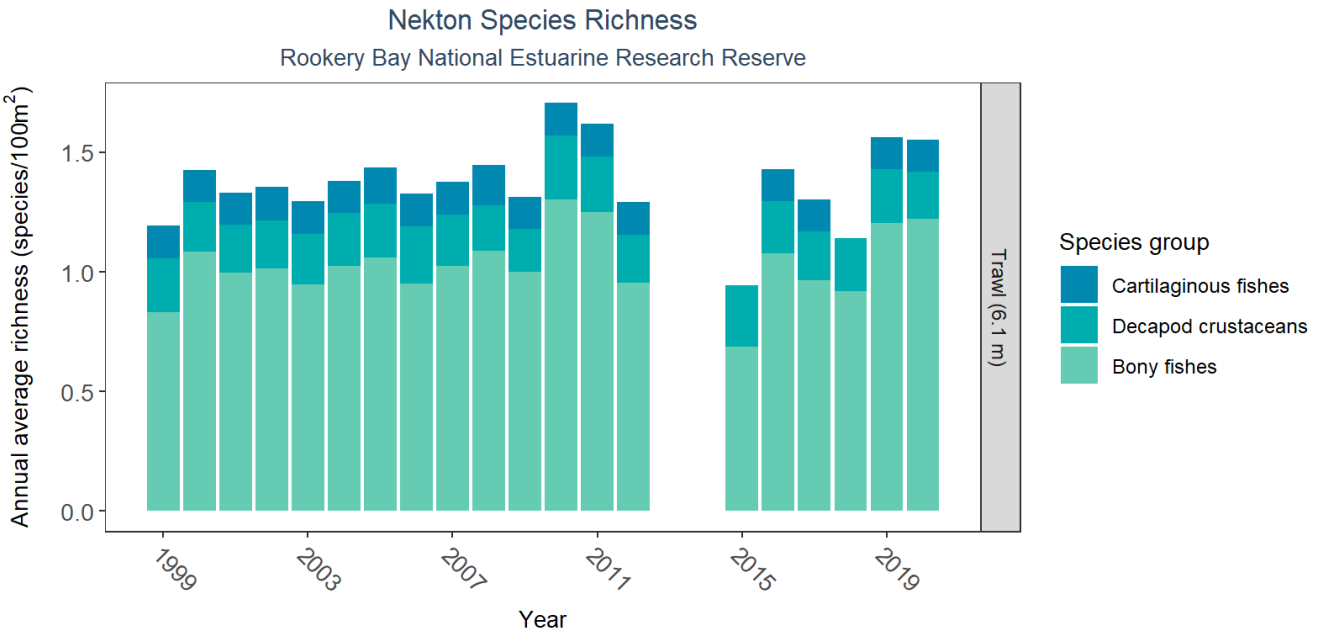

Figure 47: Bar graph(s) of annual average nekton richness over time for species groups occurring in at least 1% of samples. The bar colors represent species groups including bony fishes, cartilaginous fishes, decapod crustaceans (e.g., shrimps, crabs, and lobsters), and cephalopods (e.g., squid). Gear types and sizes are indicated in the panel label.

Table 43: Nekton Species Richness

Gear Type	*Sample Count*	*Number of Years*	*Period of Record*	*Median N of Taxa*	*Mean N of Taxa*
Trawl (6.1)	6071	20	1999 - 2020	0.27	0.63

The median annual number of taxa was 0.27 based on 6,071 observations collected by 6.1-meter trawl between 1999 and 2020.

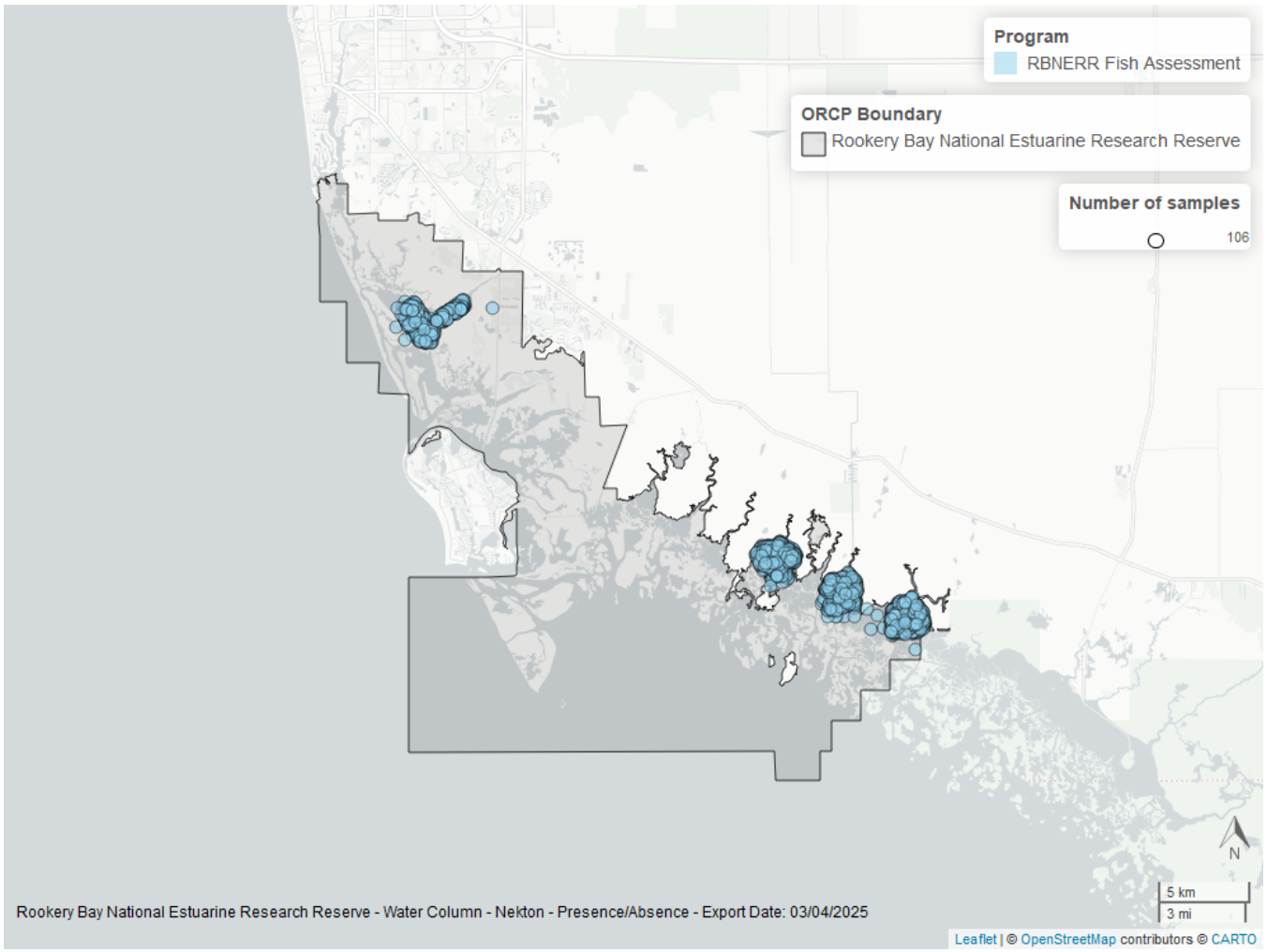

Figure 48: Map showing location of nekton sampling locations within the boundaries of *Rookery Bay National Estuarine Research Reserve*. The bubble size on the maps above reflect the amount of data available at each sampling site.

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