Rookery Bay National Estuarine Research Reserve

SEACAR Habitat Analyses

Last compiled on 08 January, 2025

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Funding & Acknowledgements

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Threshold Filtering

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

Table 1: Continuous Water Quality threshold values

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

Table 2: Discrete Water Quality threshold values

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

Parameter Name	*Units*	*Low Threshold*	*High Threshold*
Dissolved Oxygen	mg/L	-0.000001	25
Dissolved Oxygen Saturation	%	-0.000001	310
Fluorescent Dissolved Organic Matter	QSE	-	-
Light Extinction Coefficient	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	Yes	Optional parameter not collected
SWMP	-2	No	Missing data
SWMP	-3	No	Data rejected due to QA/QC
SWMP	-4	No	Outside low sensor range
SWMP	-5	No	Outside high sensor range
SWMP	0	Yes	Passed initial QA/QC checks
SWMP	1	No	Suspect data
SWMP	2	Yes	Reserved for future use
SWMP	3	Yes	Calculated data: non-vented depth/level sensor correction for changes in barometric pressure
SWMP	4	Yes	Historical: Pre-auto QA/QC
SWMP	5	Yes	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, andwater 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-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_Chlorophyll_a_uncorrected_for_pheophytin-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_Colored_dissolved_organic_matter_CDOM-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_Dissolved_Oxygen-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_Dissolved_Oxygen_Saturation-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_pH-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_Salinity-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_Secchi_Depth-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_Total_Nitrogen-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_Total_Phosphorus-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_Total_Suspended_Solids_TSS-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_Turbidity-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_Water_Temperature-2024-Dec-08.txt*

Chlorophyll a, Corrected for Pheophytin - Discrete Water Quality

Seasonal Kendall-Tau Trend Analysis

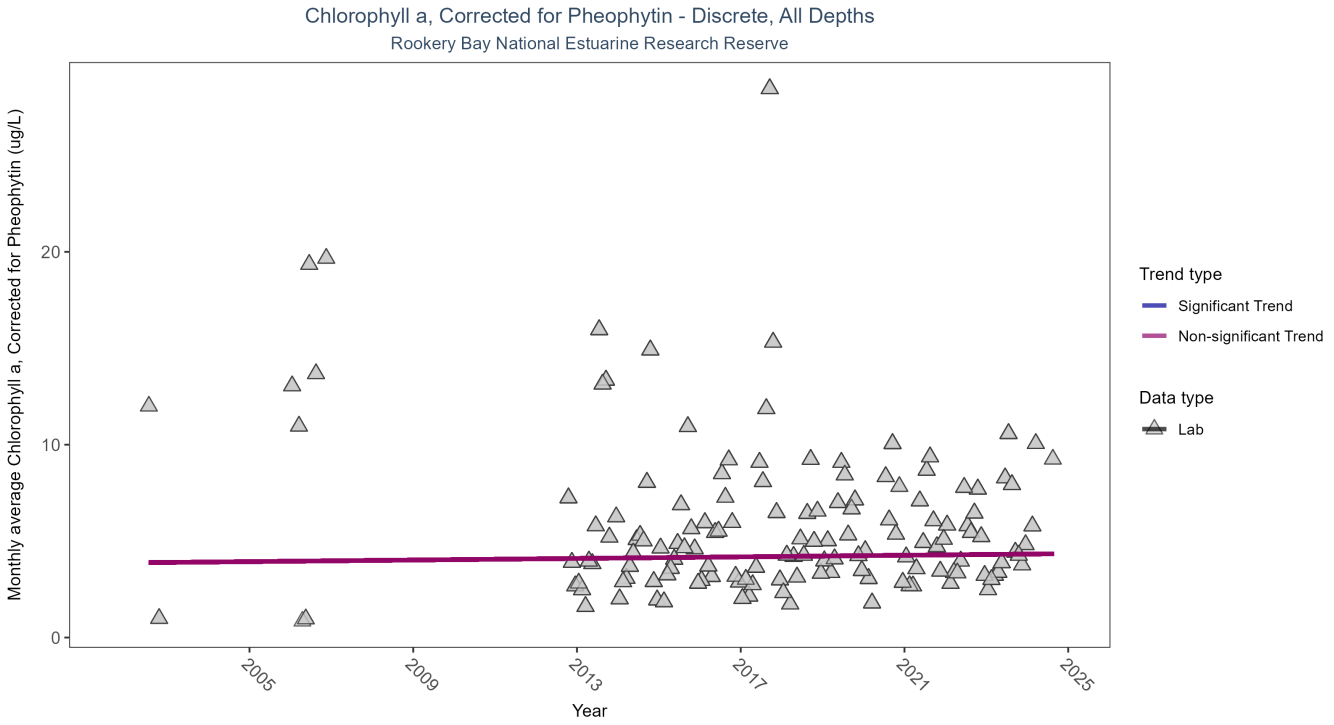

Figure 1: Seasonal Kendall-Tau Results for Chlorophyll a, Corrected for Pheophytin - Discrete

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

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	2170	15	4.1	TRUE	0.031	0.6191	0.0206	3.8746	11.3481	0.4146	0

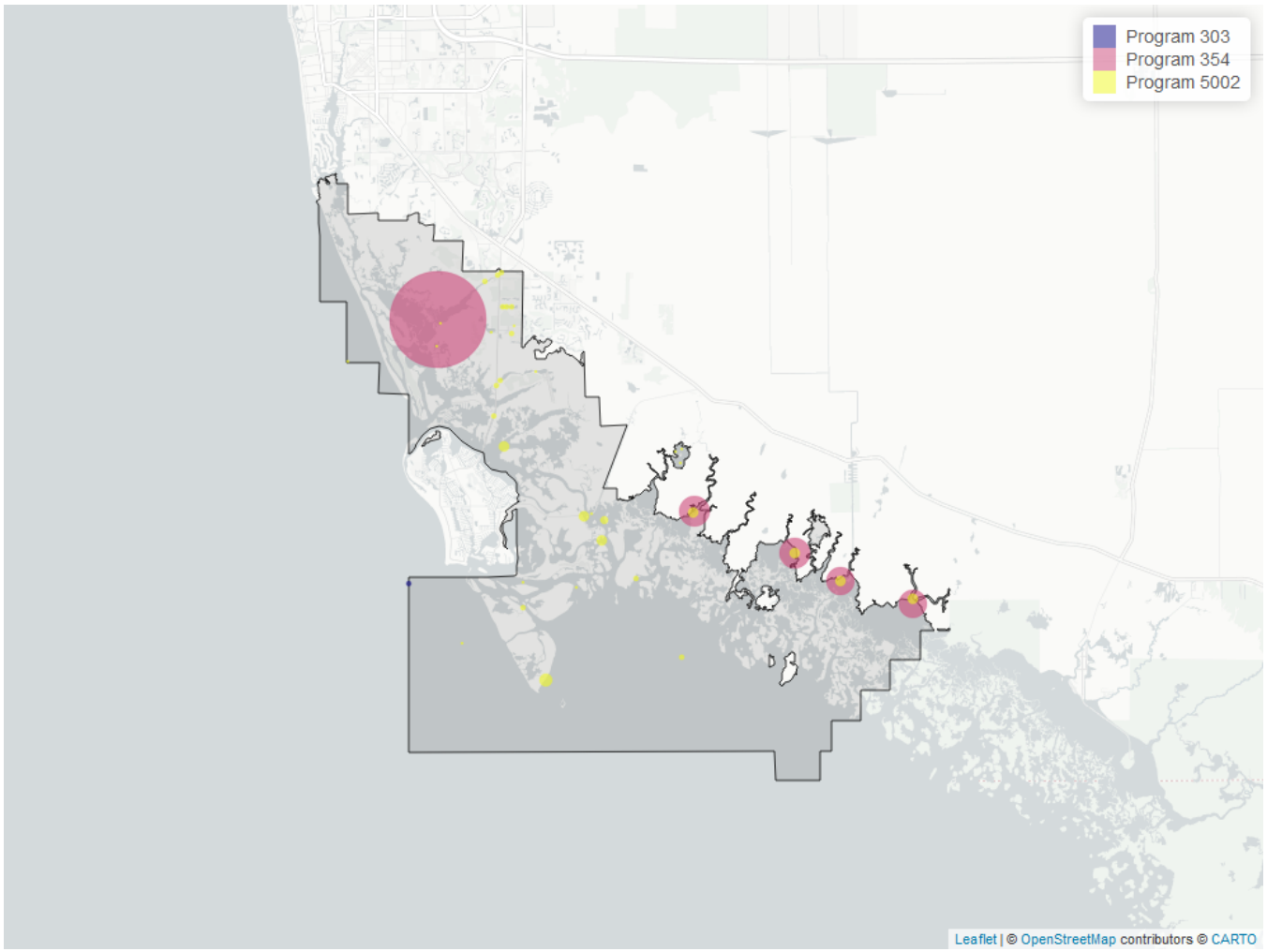

Figure 2: Map showing location of Discrete sampling sites for Chlorophyll a, Corrected for Pheophytin. The bubble size on the maps below reflect the amount of data available at each sampling site.

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

ProgramID	*N_Data*	*YearMin*	*YearMax*
354	1993	2012	2024
5002	209	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 Water Quality

Seasonal Kendall-Tau Trend Analysis

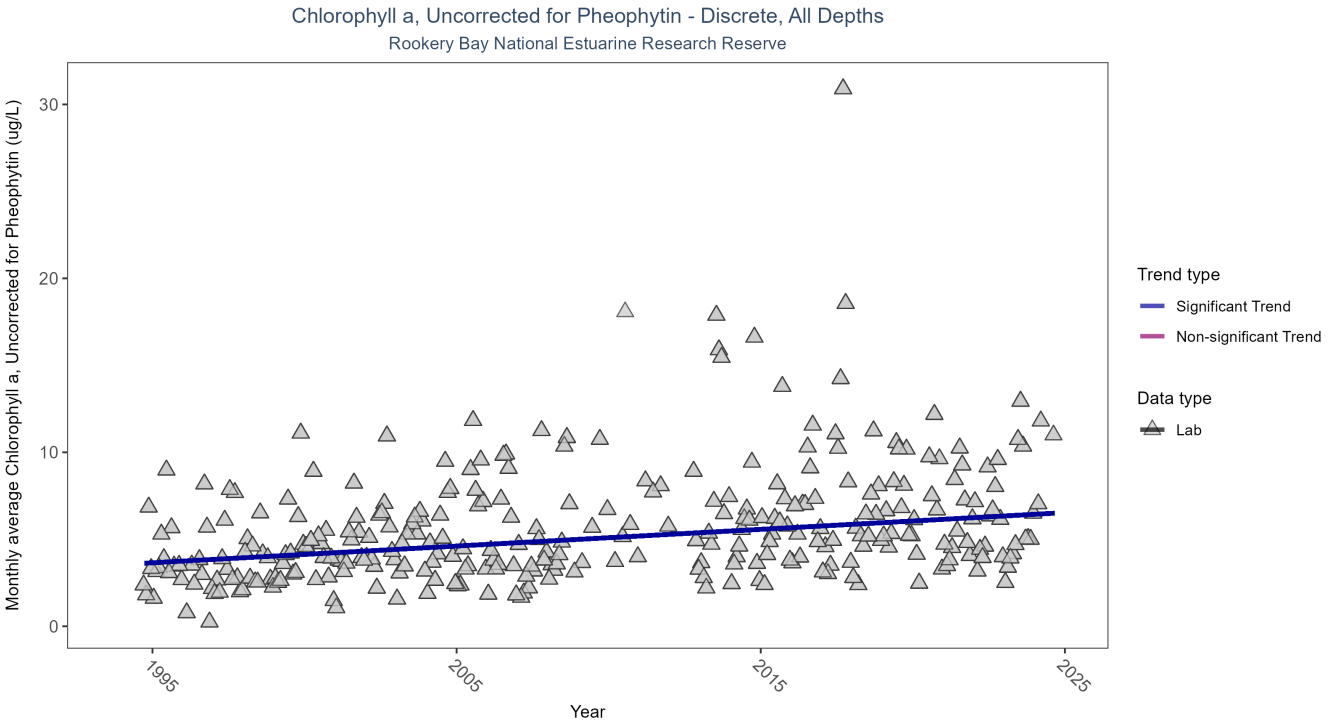

Figure 3: Seasonal Kendall-Tau Results for Chlorophyll a, Uncorrected for Pheophytin - Discrete

Table 8: Seasonal Kendall-Tau Trend Analysis for Chlorophyll a, Uncorrected for Pheophytin

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	5307	31	4.4	TRUE	0.3249	0	0.096	3.5549	5.7146	0.8917	1

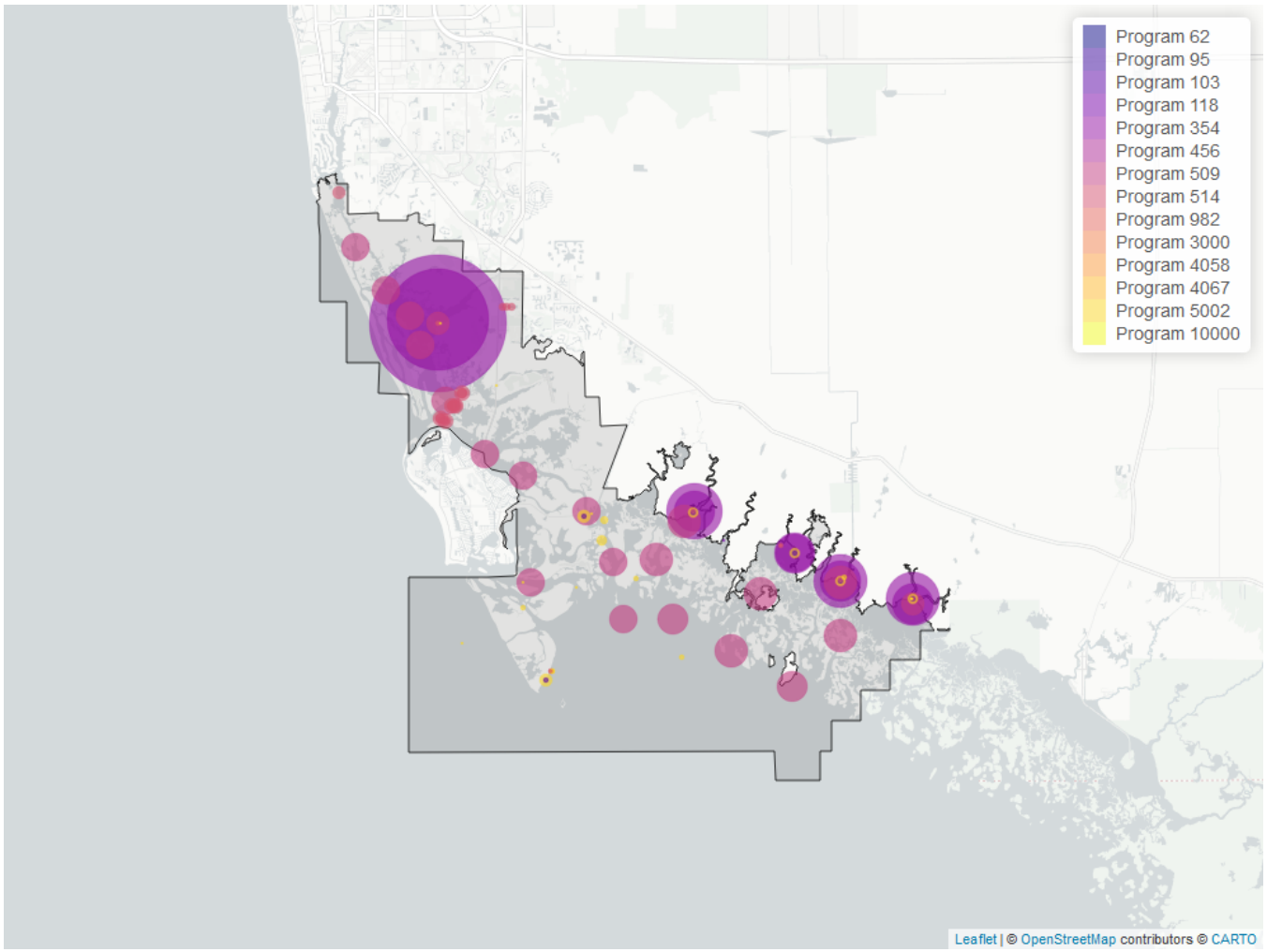

Figure 4: Map showing location of Discrete sampling sites for Chlorophyll a, Uncorrected for Pheophytin. The bubble size on the maps below reflect the amount of data available at each sampling site.

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

ProgramID	*N_Data*	*YearMin*	*YearMax*
354	7157	2002	2024
509	2746	1994	2008
514	413	2001	2017
5002	171	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 Water Quality

Seasonal Kendall-Tau Trend Analysis

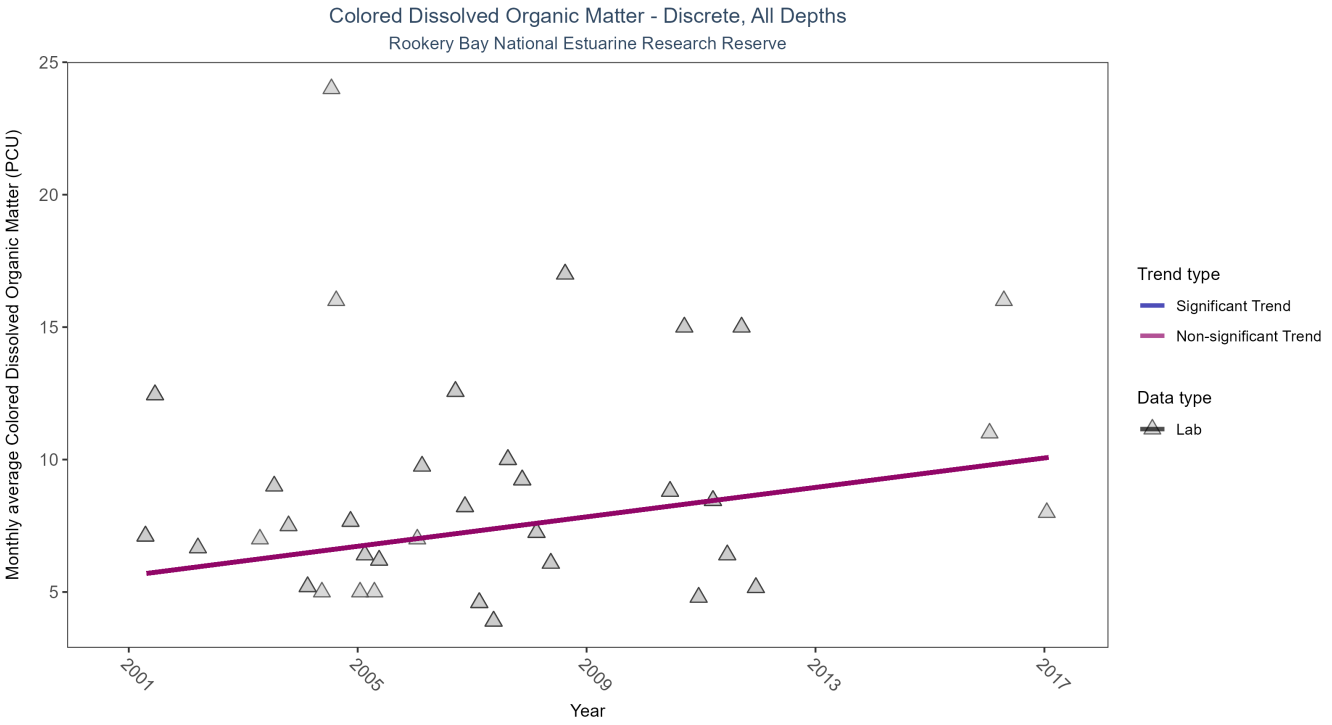

Figure 5: Seasonal Kendall-Tau Results for Colored Dissolved Organic Matter - Discrete

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

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	193	12	8	TRUE	0.3619	0.1533	0.2778	5.6154	7.8132	0.6471	0

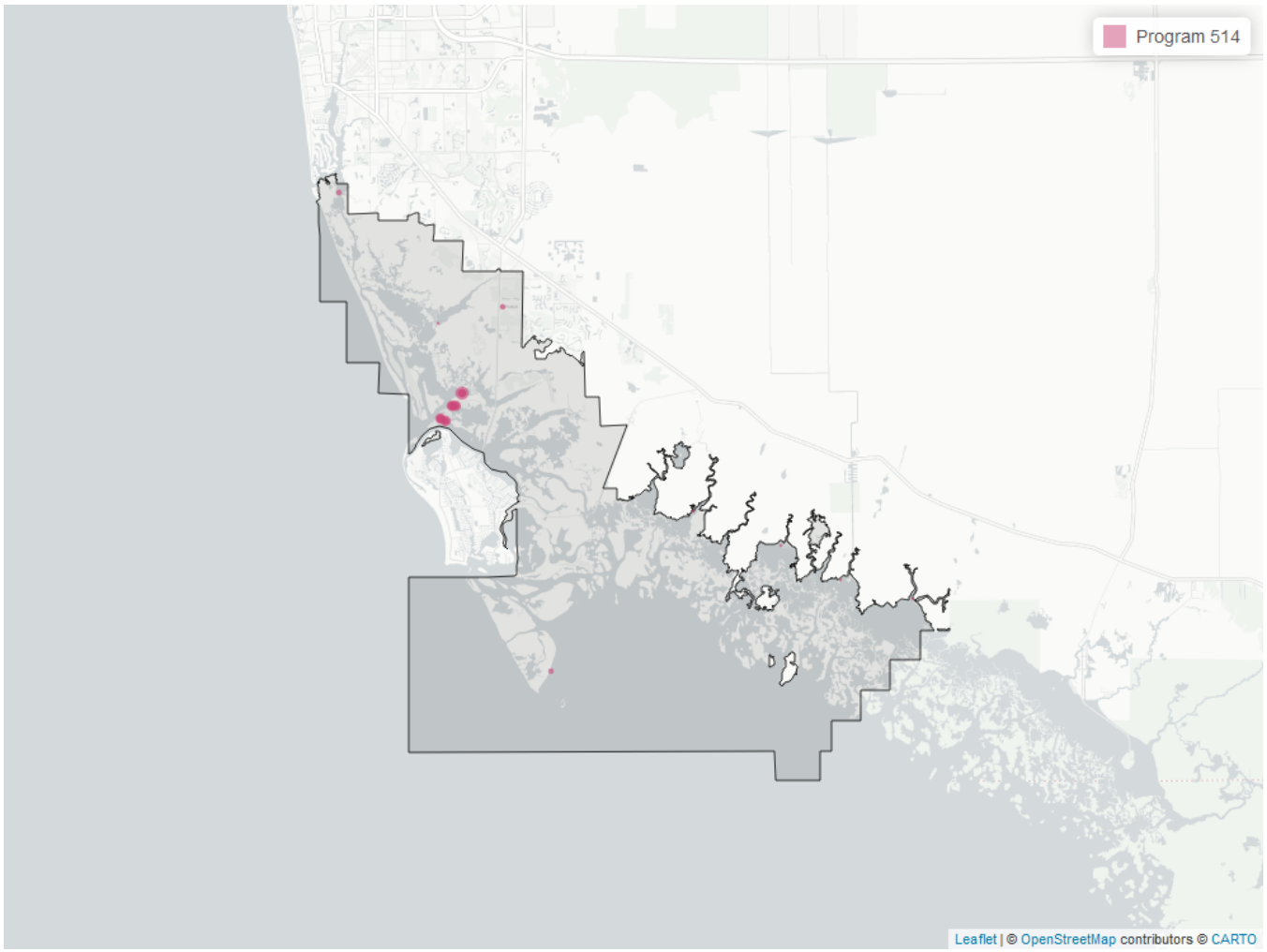

Figure 6: Map showing location of Discrete sampling sites for Colored Dissolved Organic Matter. The bubble size on the maps below reflect the amount of data available at each sampling site.

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 Water Quality

Seasonal Kendall-Tau Trend Analysis

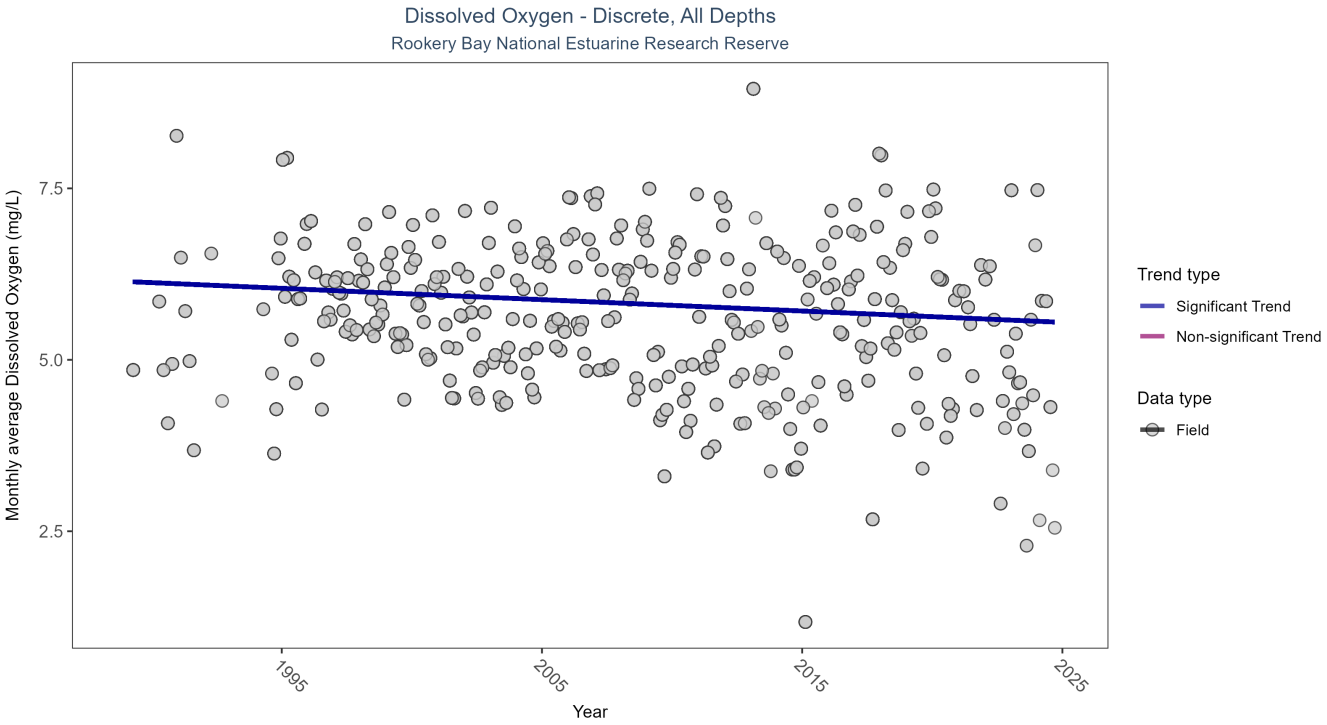

Figure 7: Seasonal Kendall-Tau Results for Dissolved Oxygen - Discrete

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

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	15338	35	5.8	TRUE	-0.1264	0.0006	-0.0166	6.142	19.1291	0.0588	-1

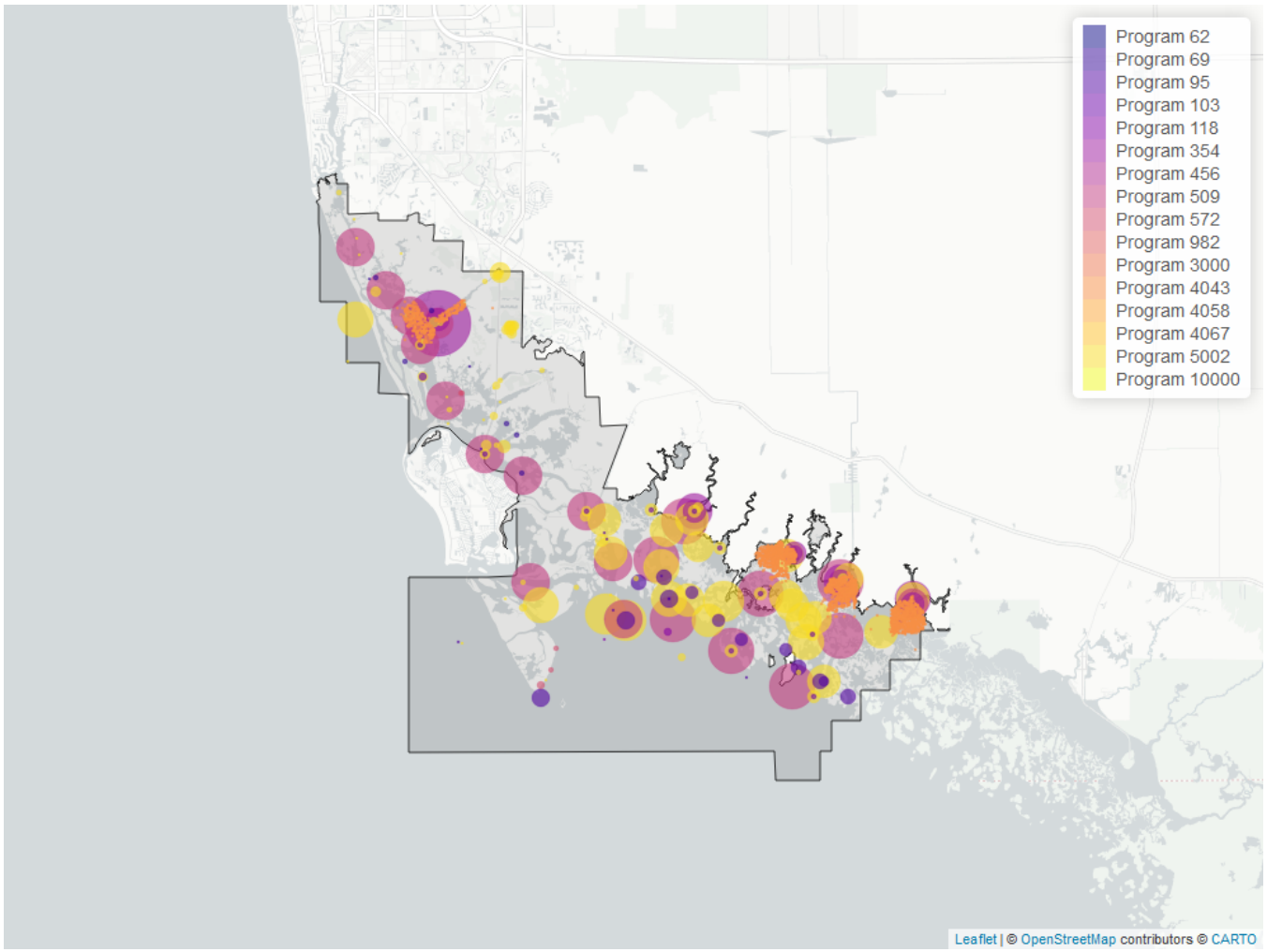

Figure 8: Map showing location of Discrete sampling sites for Dissolved Oxygen. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 13: Programs contributing data for Dissolved Oxygen

ProgramID	*N_Data*	*YearMin*	*YearMax*
509	5403	1994	2008
5002	5158	1989	2024
4043	2972	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 Water Quality

Seasonal Kendall-Tau Trend Analysis

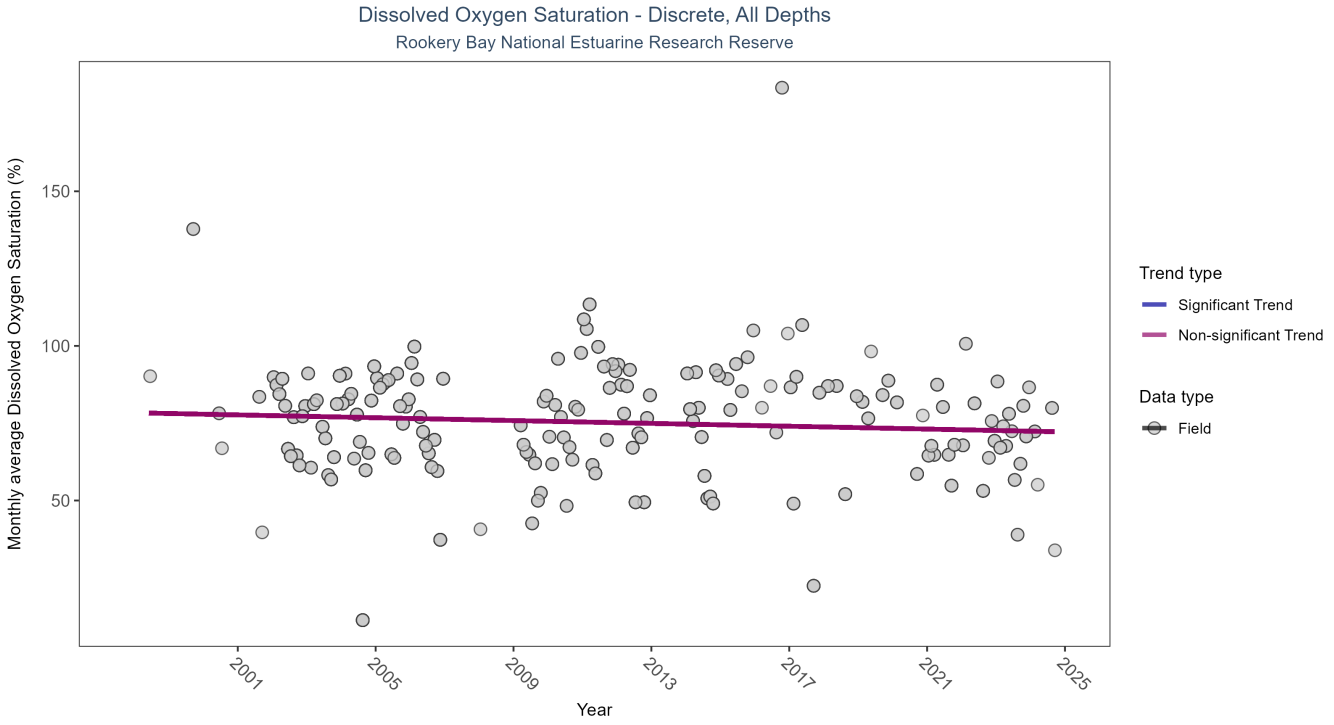

Figure 9: Seasonal Kendall-Tau Results for Dissolved Oxygen Saturation - Discrete

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

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	1399	25	78	TRUE	-0.0857	0.133	-0.2289	78.3704	11.3459	0.4148	0

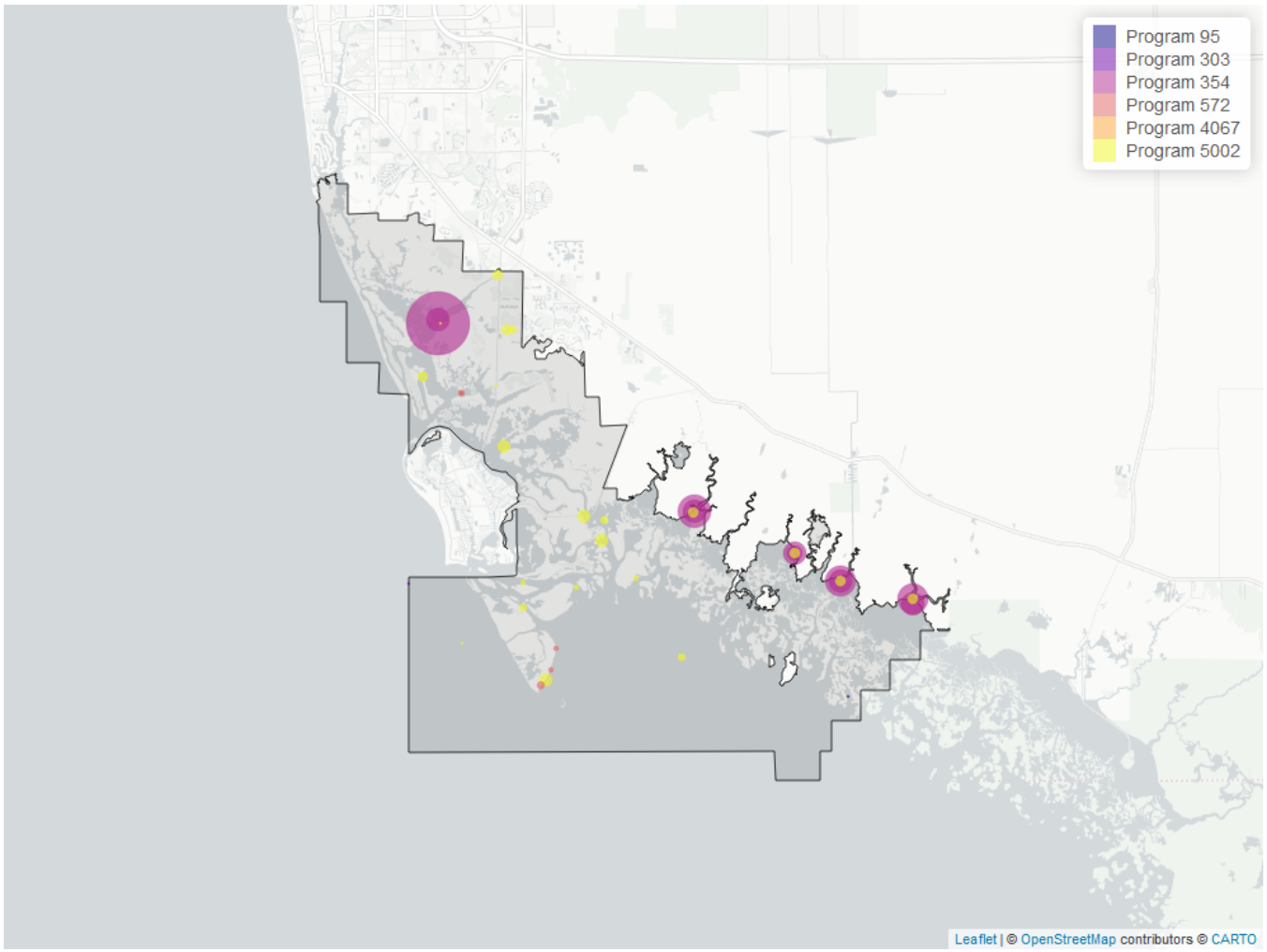

Figure 10: Map showing location of Discrete sampling sites for Dissolved Oxygen Saturation. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 15: Programs contributing data for Dissolved Oxygen Saturation

ProgramID	*N_Data*	*YearMin*	*YearMax*
354	1532	2002	2024
5002	252	2015	2024
572	27	1998	2005
303	1	2023	2023
95	1	2008	2008

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 Water Quality

Seasonal Kendall-Tau Trend Analysis

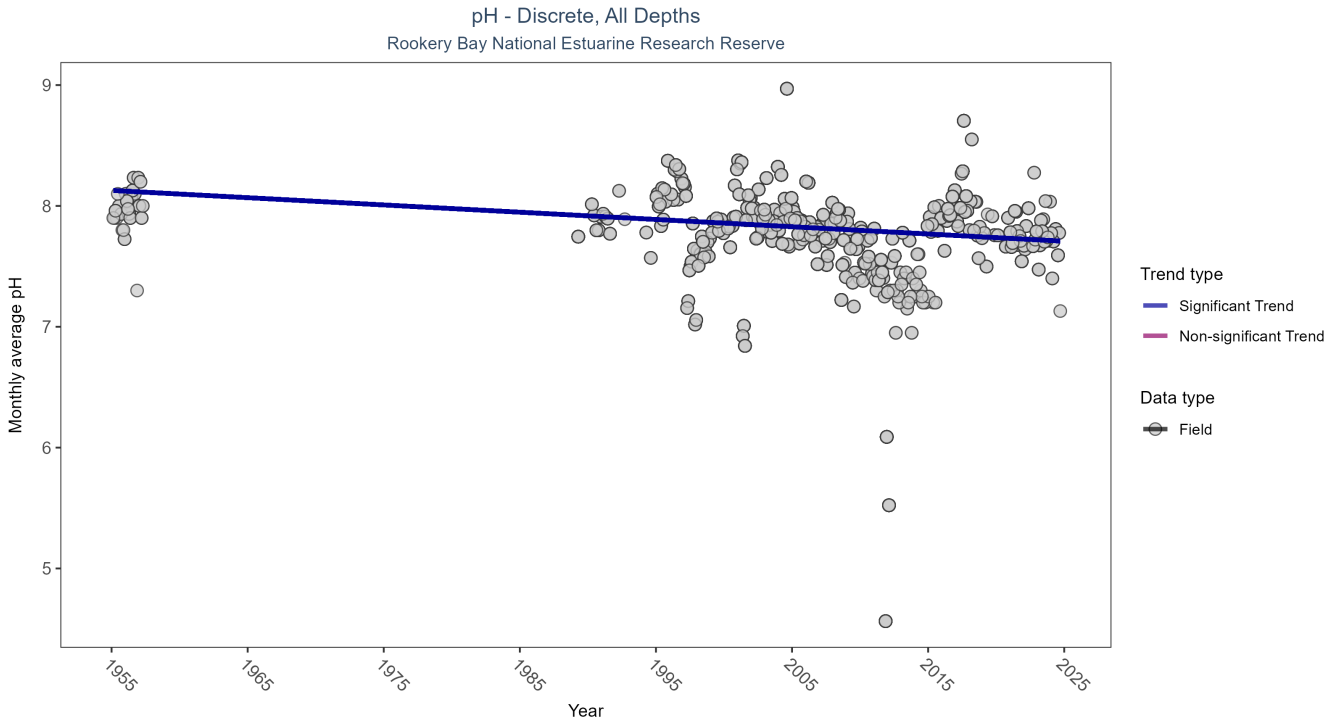

Figure 11: Seasonal Kendall-Tau Results for pH - Discrete

Table 16: Seasonal Kendall-Tau Trend Analysis for pH

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	7354	38	7.86	TRUE	-0.2247	0	-0.006	8.1283	19.7437	0.049	-1

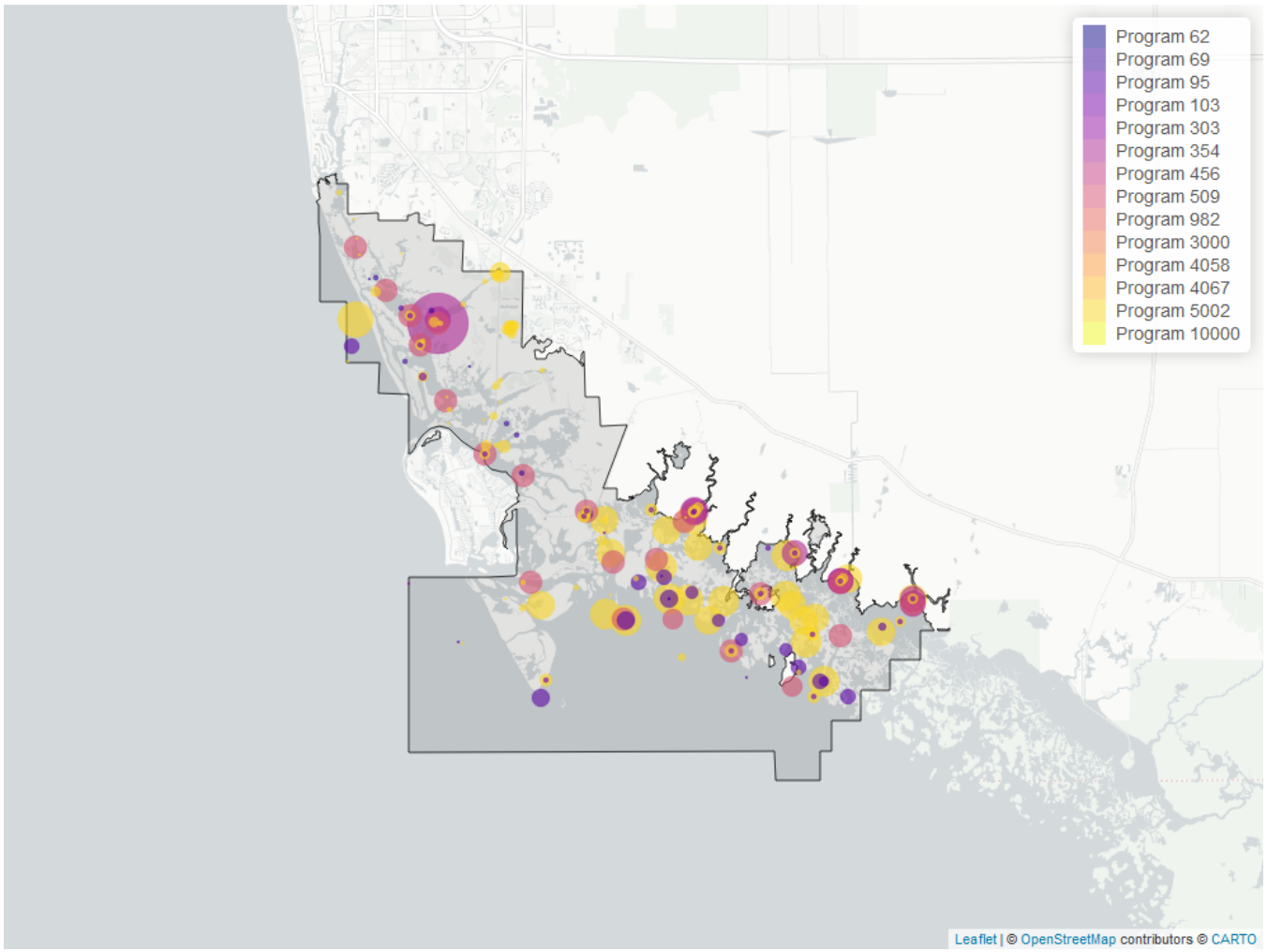

Figure 12: Map showing location of Discrete sampling sites for pH. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 17: Programs contributing data for pH

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	4113	1989	2024
509	1719	2001	2008
354	1350	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 Water Quality

Seasonal Kendall-Tau Trend Analysis

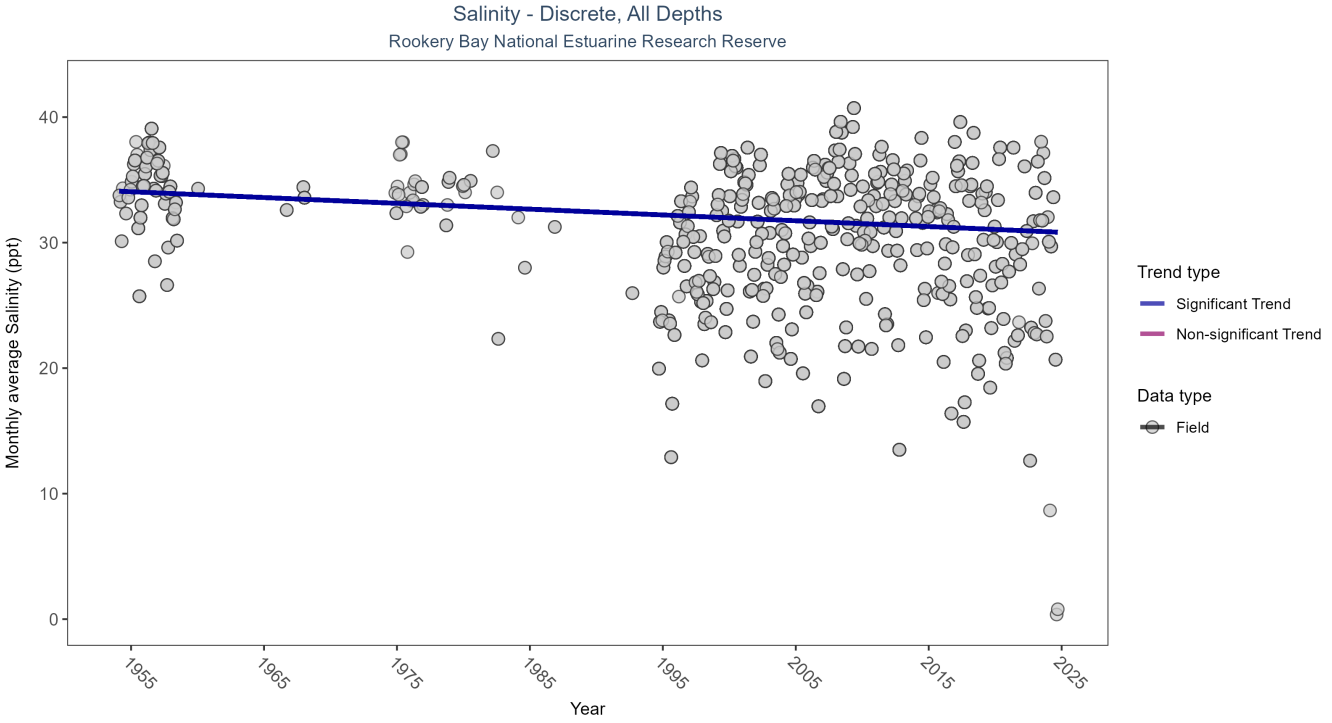

Figure 13: Seasonal Kendall-Tau Results for Salinity - Discrete

Table 18: Seasonal Kendall-Tau Trend Analysis for Salinity

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	16801	53	32.7	TRUE	-0.1597	0	-0.0462	34.1006	11.0807	0.4365	-1

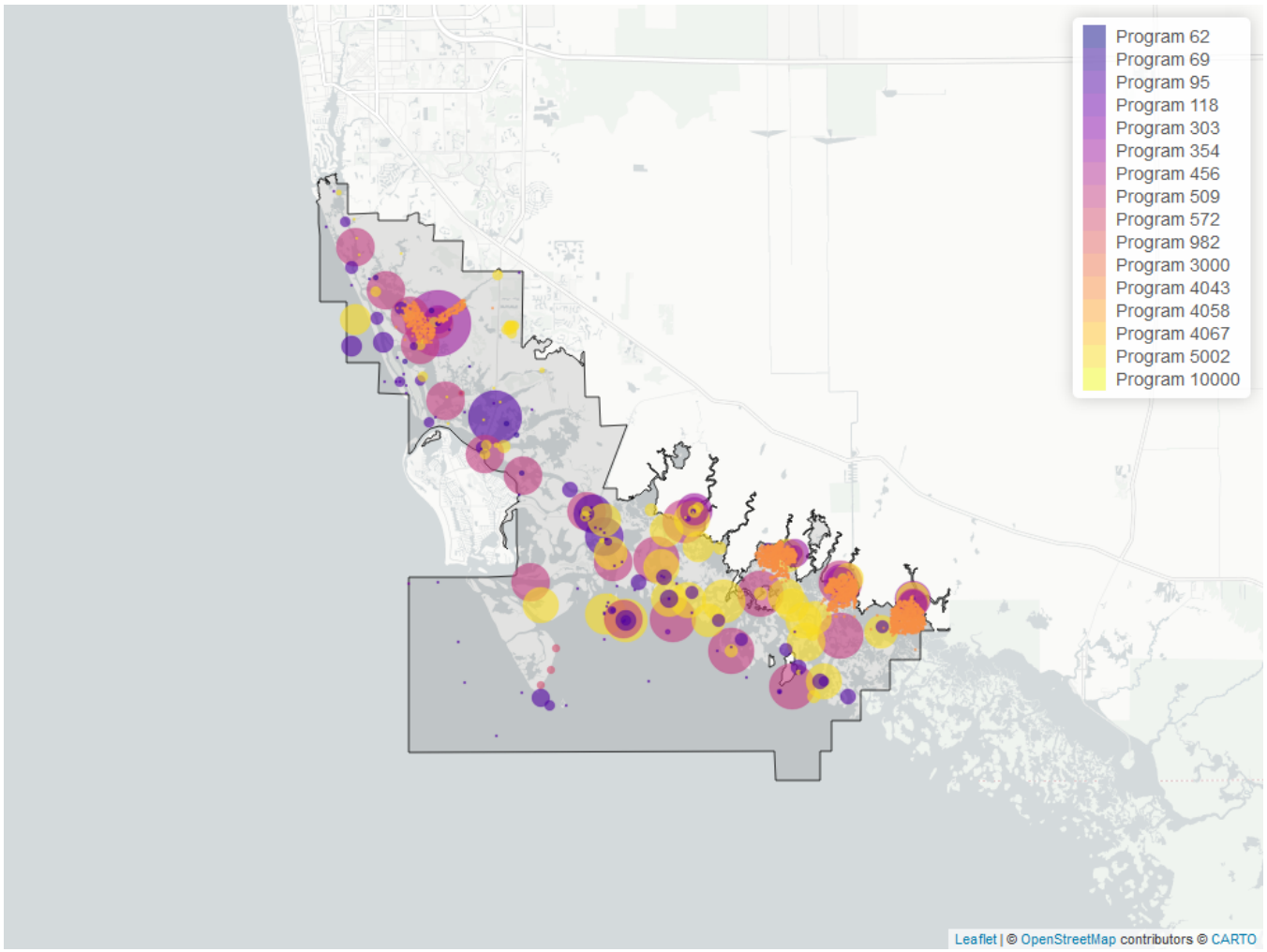

Figure 14: Map showing location of Discrete sampling sites for Salinity. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 19: Programs contributing data for Salinity

ProgramID	*N_Data*	*YearMin*	*YearMax*
509	5387	1994	2008
5002	5149	1989	2024
4043	3044	1999	2020
354	1919	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 Water Quality

Seasonal Kendall-Tau Trend Analysis

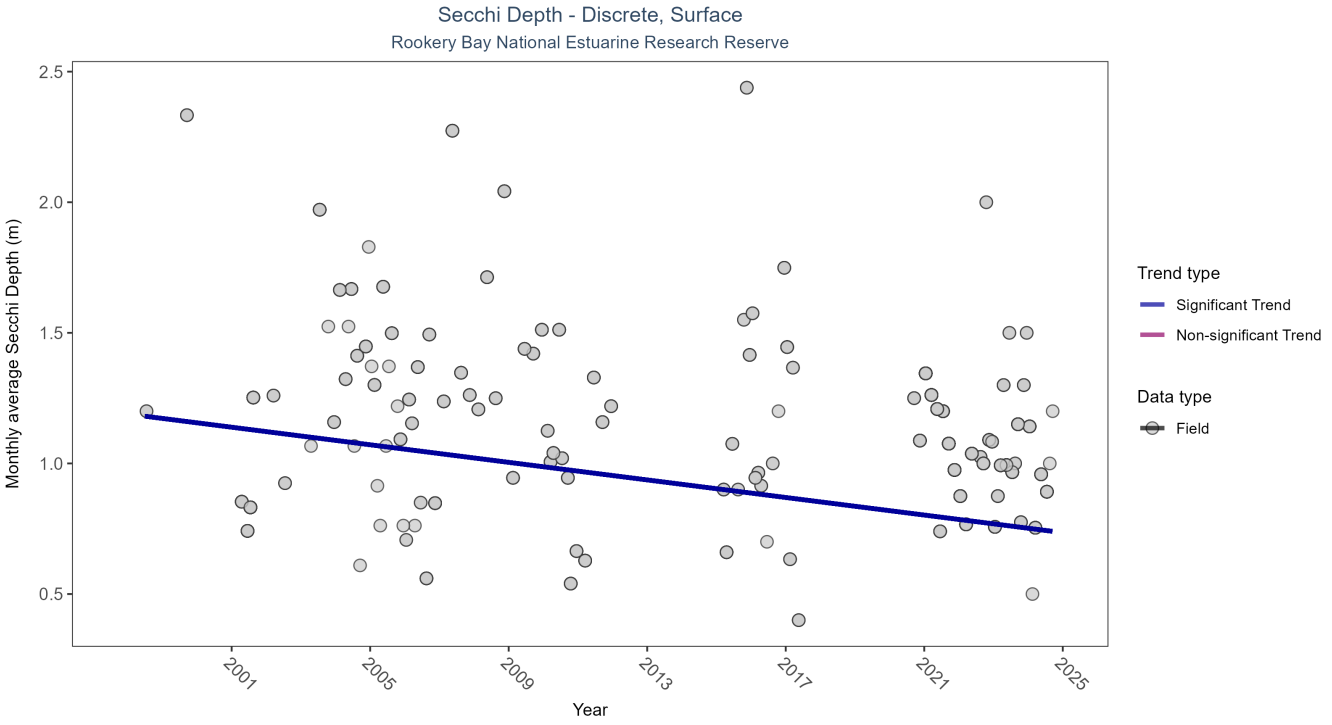

Figure 15: Seasonal Kendall-Tau Results for Secchi Depth - Discrete

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

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
Surface	756	21	1.0668	TRUE	-0.2354	0.0007	-0.0168	1.1891	14.43	0.2101	-1

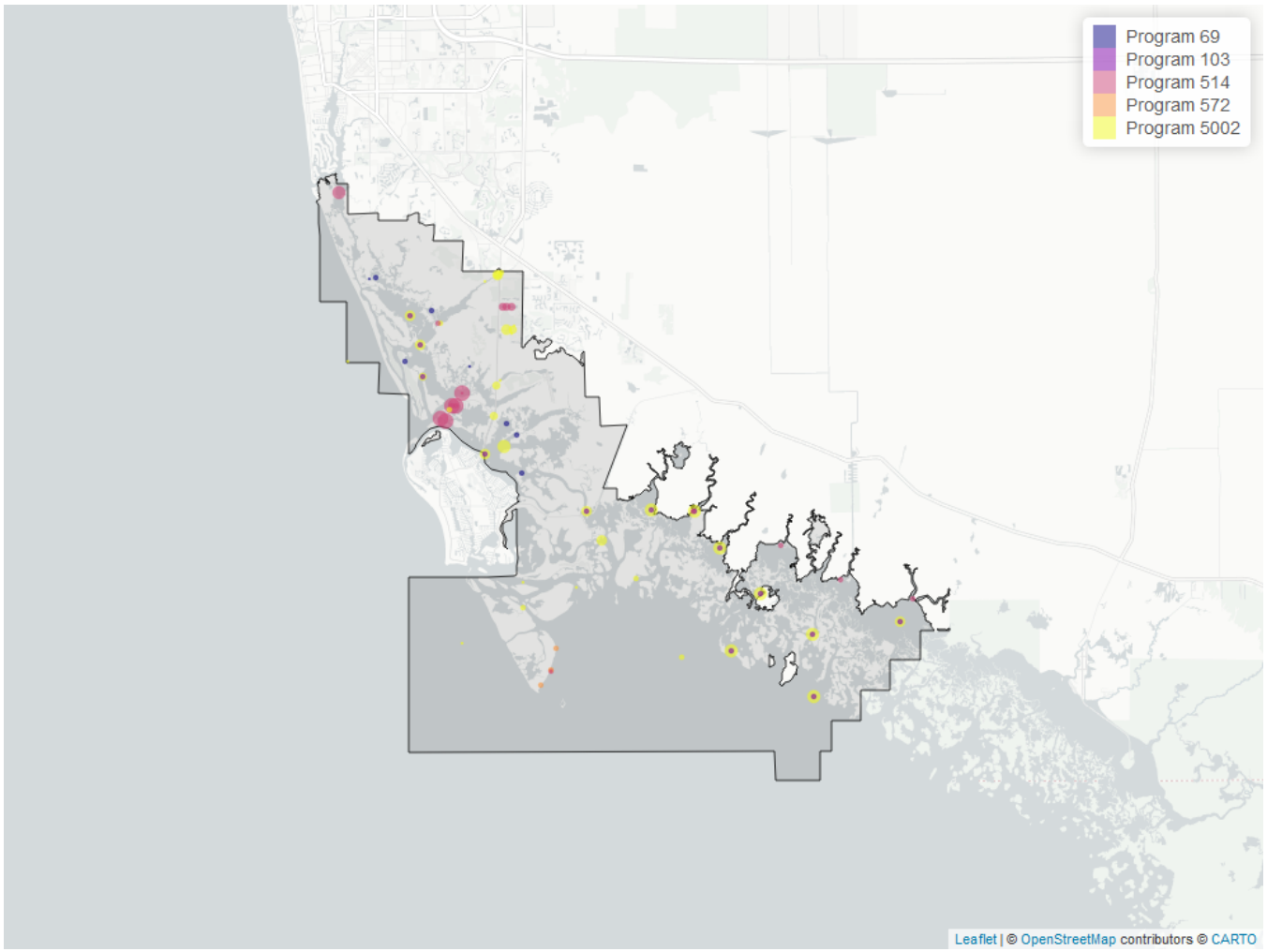

Figure 16: Map showing location of Discrete sampling sites for Secchi Depth. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 21: Programs contributing data for Secchi Depth

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	397	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 Water Quality

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

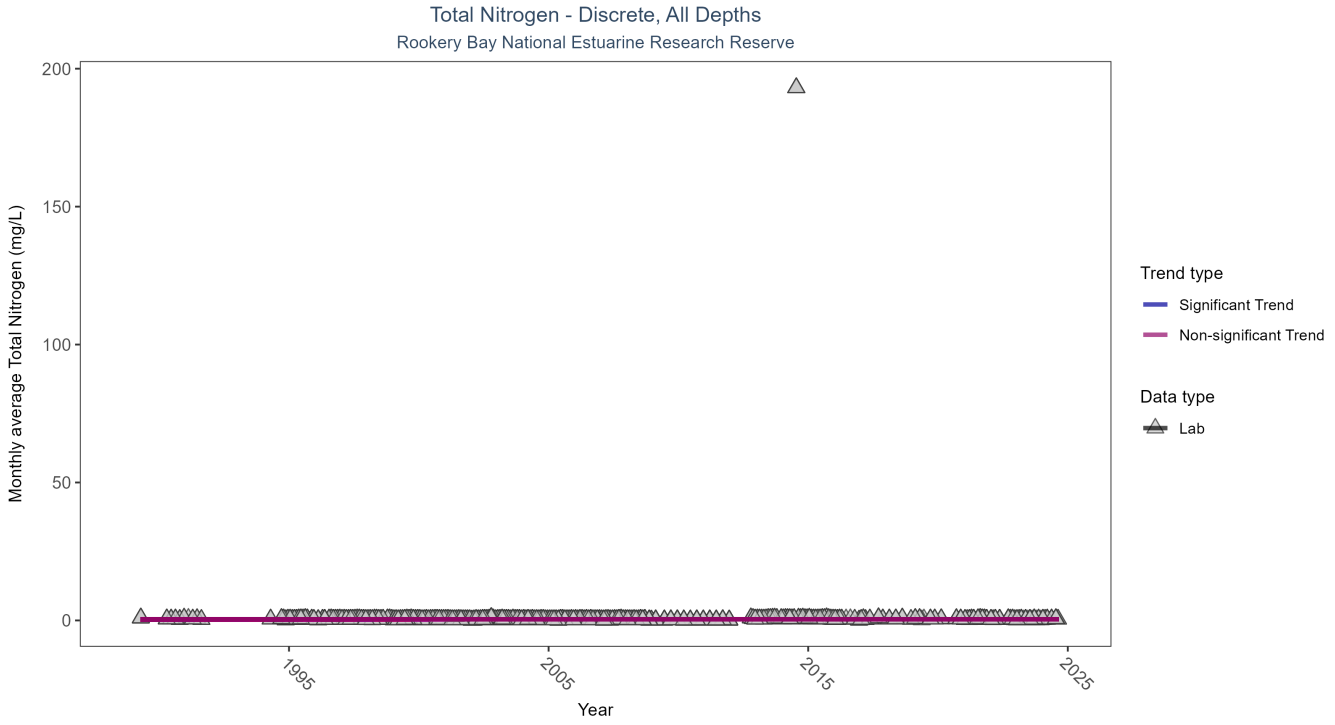

Figure 17: Seasonal Kendall-Tau Results for Total Nitrogen - Discrete

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

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	5314	34	0.318	TRUE	0.0242	0.6187	0.0009	0.3828	12.0795	0.3577	0

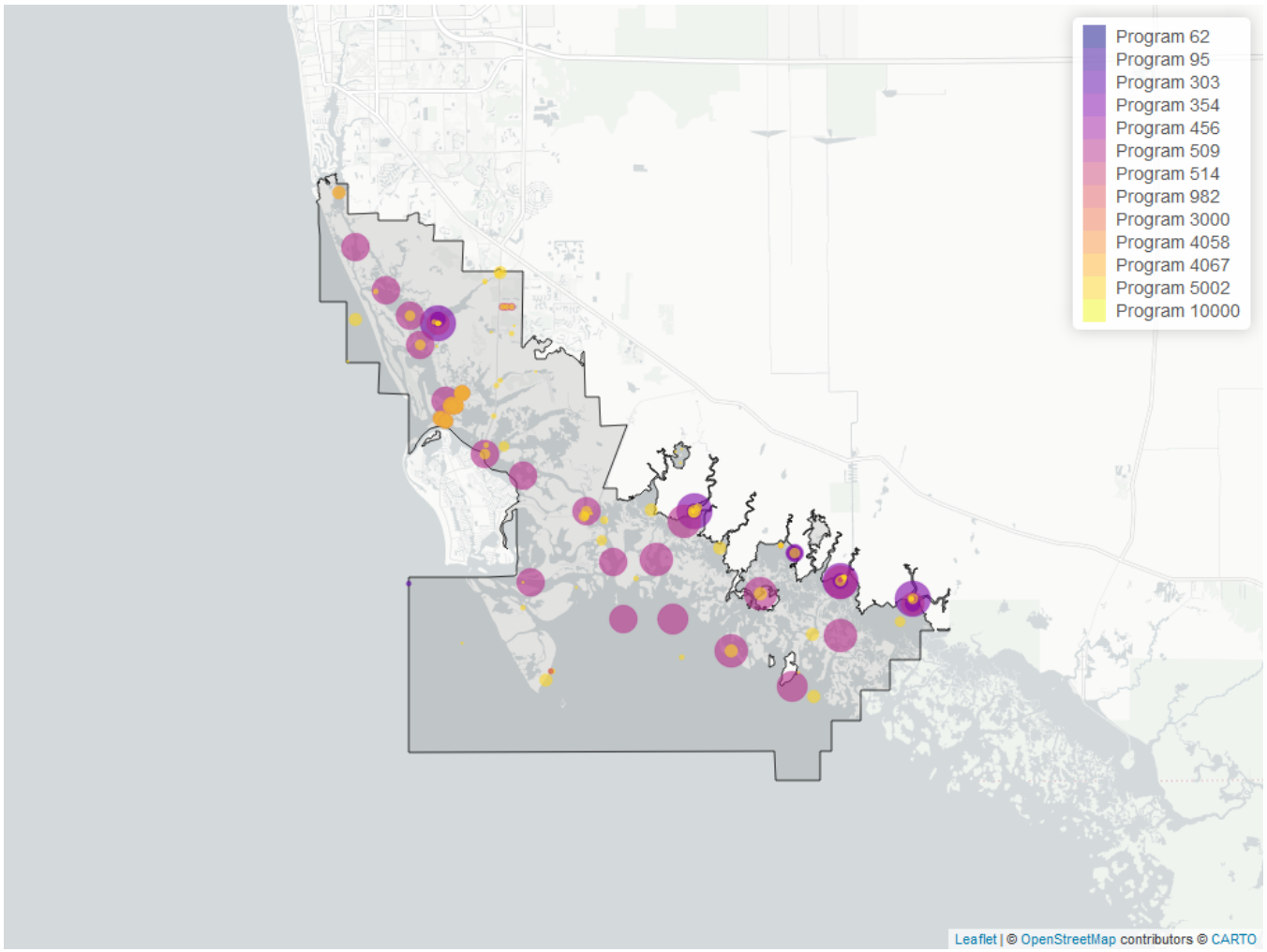

Figure 18: Map showing location of Discrete sampling sites for Total Nitrogen. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 23: Programs contributing data for Total Nitrogen

ProgramID	*N_Data*	*YearMin*	*YearMax*
509	2758	1994	2008
5002	1121	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 Water Quality

Seasonal Kendall-Tau Trend Analysis

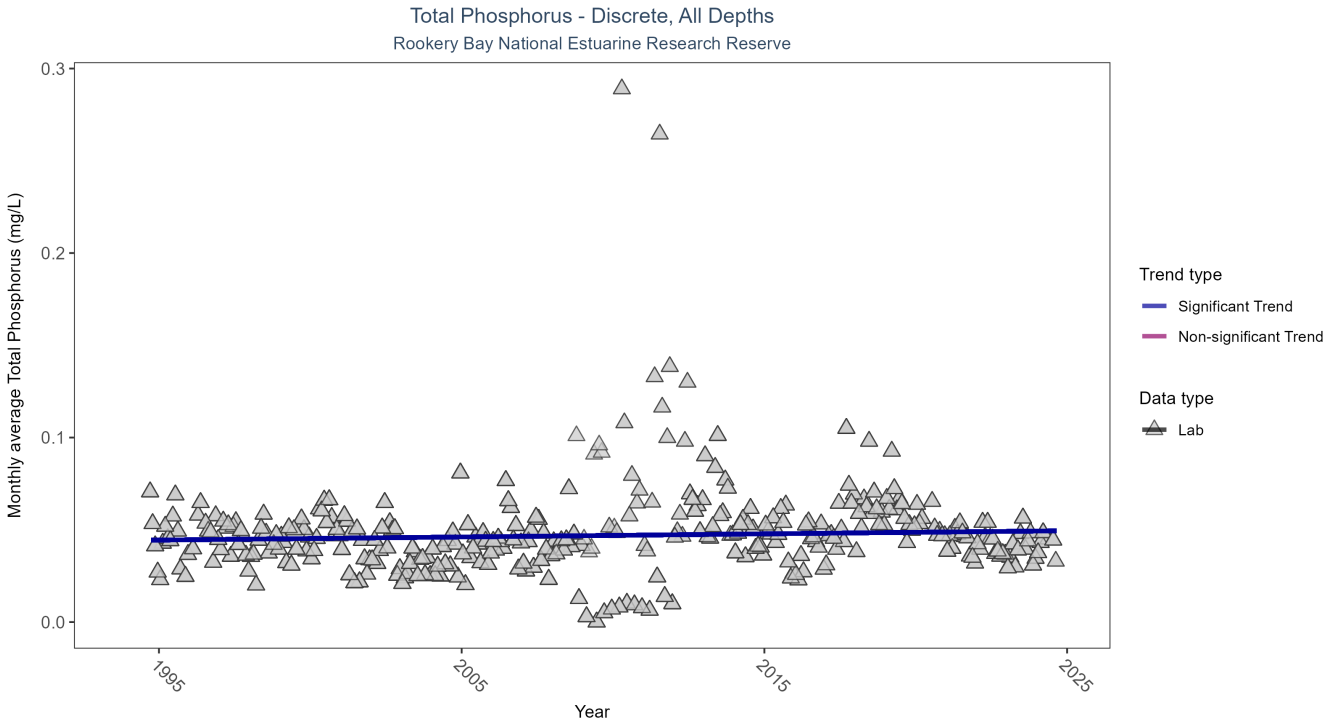

Figure 19: Seasonal Kendall-Tau Results for Total Phosphorus - Discrete

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

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	5539	31	0.04	TRUE	0.0757	0.0458	0.0002	0.0443	3.7406	0.9769	1

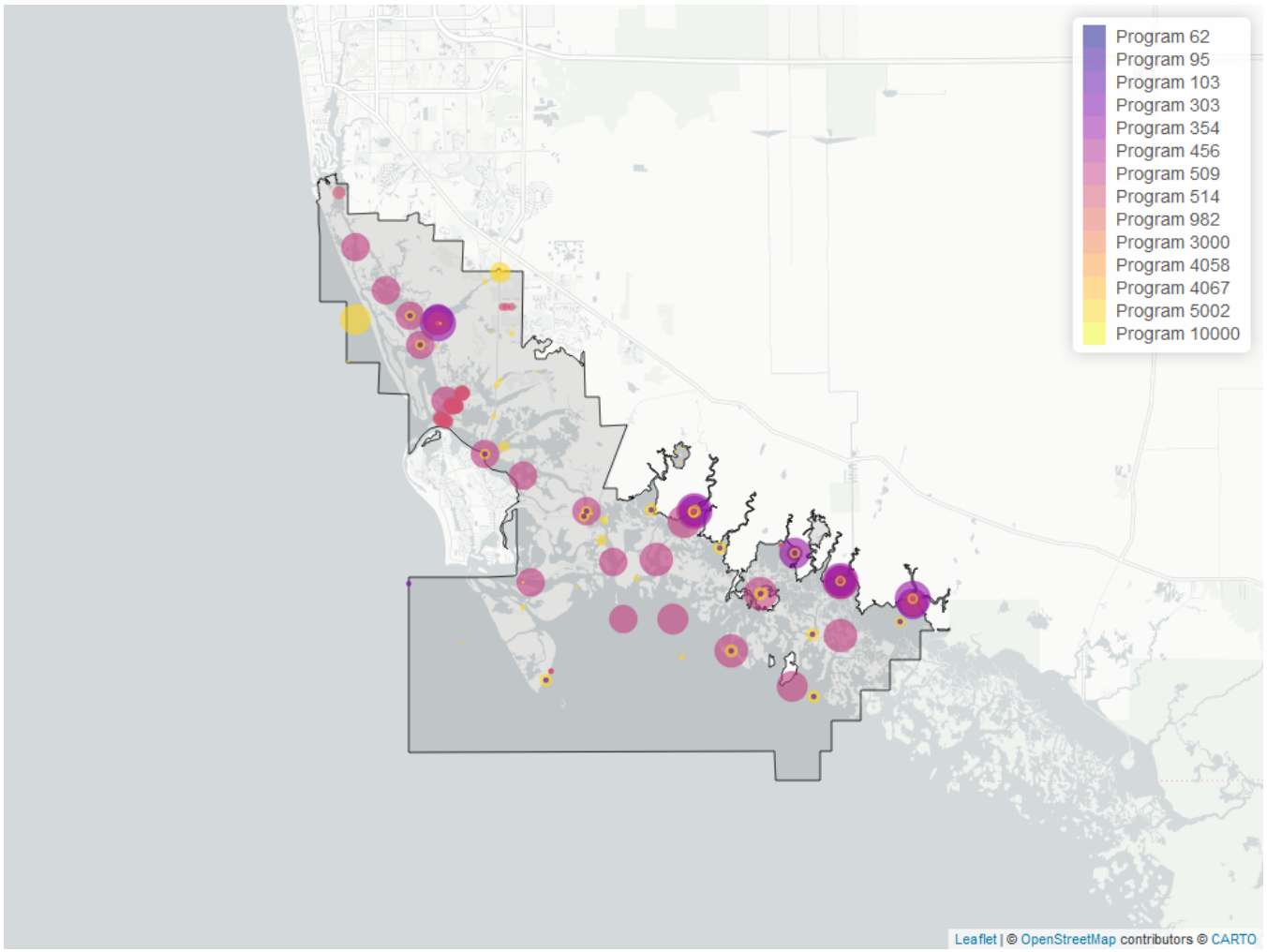

Figure 20: Map showing location of Discrete sampling sites for Total Phosphorus. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 25: Programs contributing data for Total Phosphorus

ProgramID	*N_Data*	*YearMin*	*YearMax*
509	2735	1994	2008
354	1482	2002	2024
5002	665	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 Water Quality

Seasonal Kendall-Tau Trend Analysis

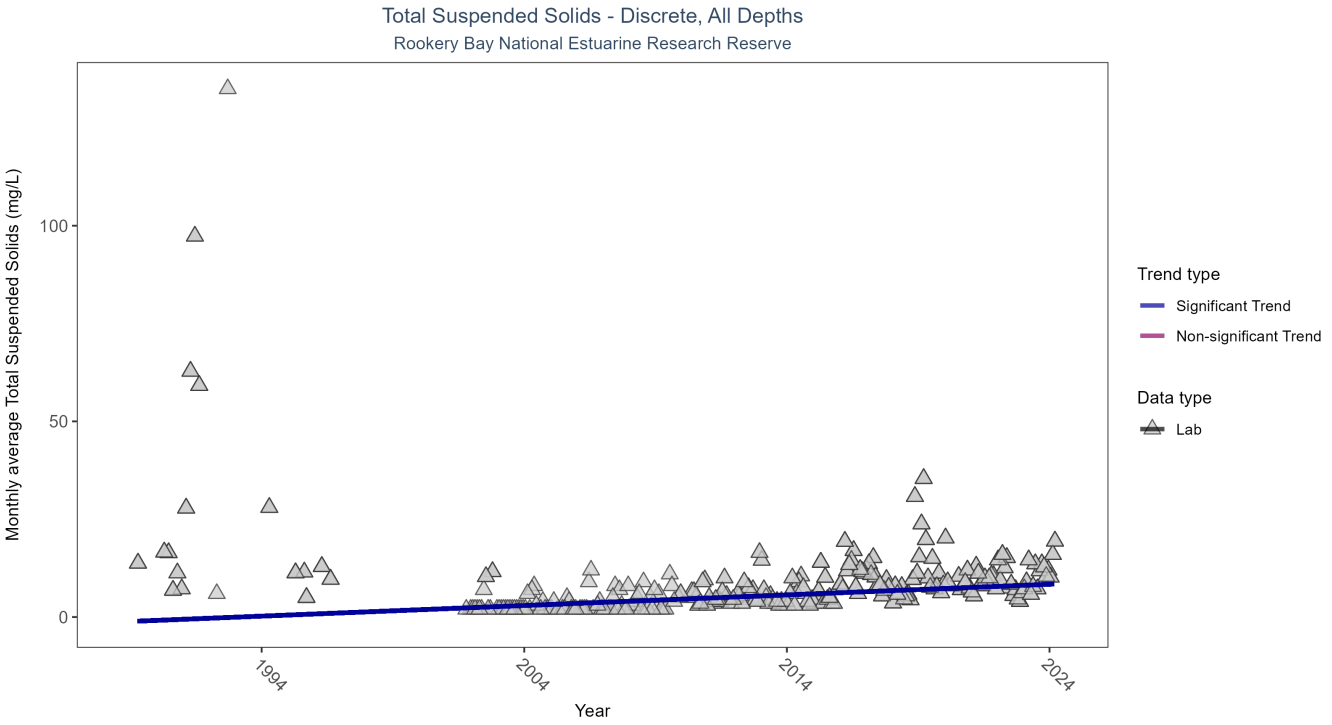

Figure 21: Seasonal Kendall-Tau Results for Total Suspended Solids - Discrete

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

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	836	31	7	TRUE	0.3656	0	0.2714	-1.125	22.5559	0.0204	1

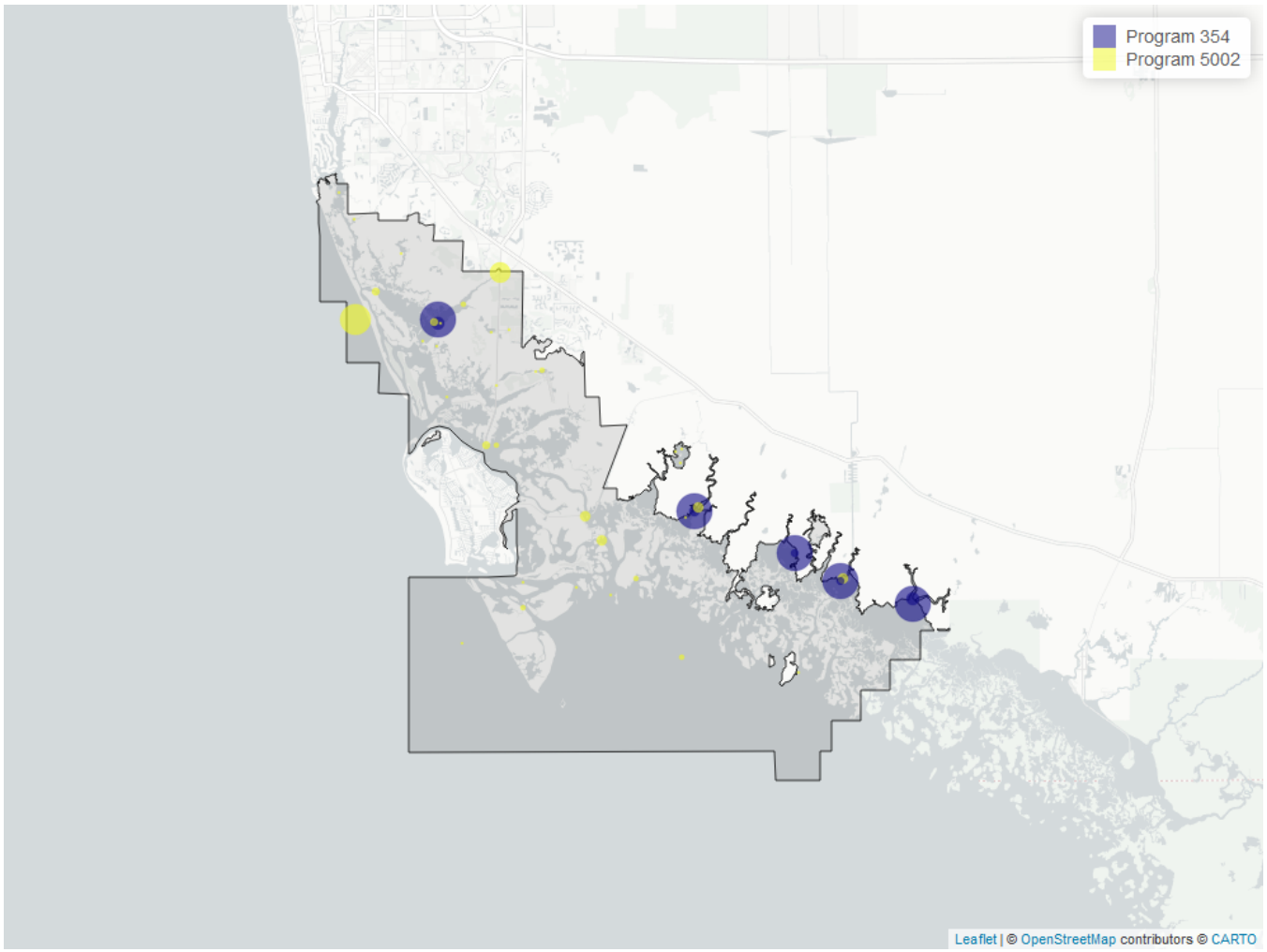

Figure 22: Map showing location of Discrete sampling sites for Total Suspended Solids. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 27: Programs contributing data for Total Suspended Solids

ProgramID	*N_Data*	*YearMin*	*YearMax*
354	1035	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 Water Quality

Seasonal Kendall-Tau Trend Analysis

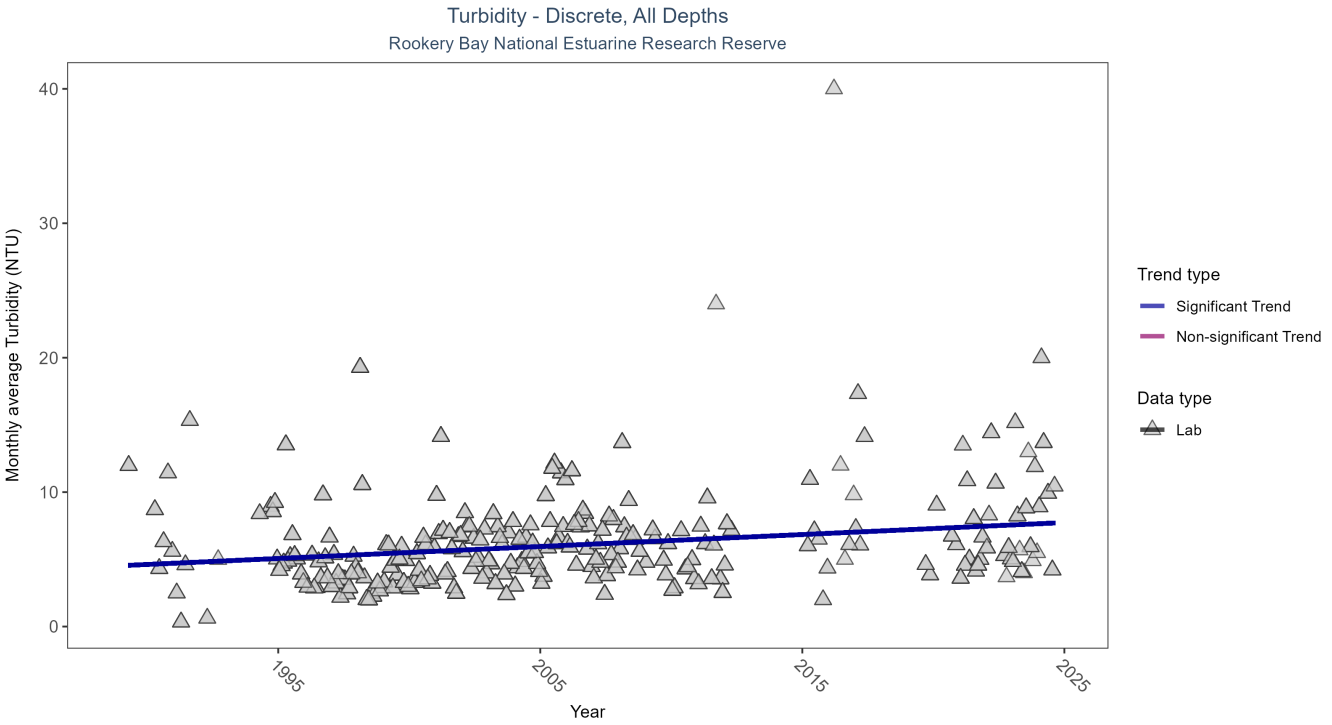

Figure 23: Seasonal Kendall-Tau Results for Turbidity - Discrete

Table 28: Seasonal Kendall-Tau Trend Analysis for Turbidity

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	6377	32	4.37	TRUE	0.2069	0	0.089	4.5298	15.1255	0.1768	1

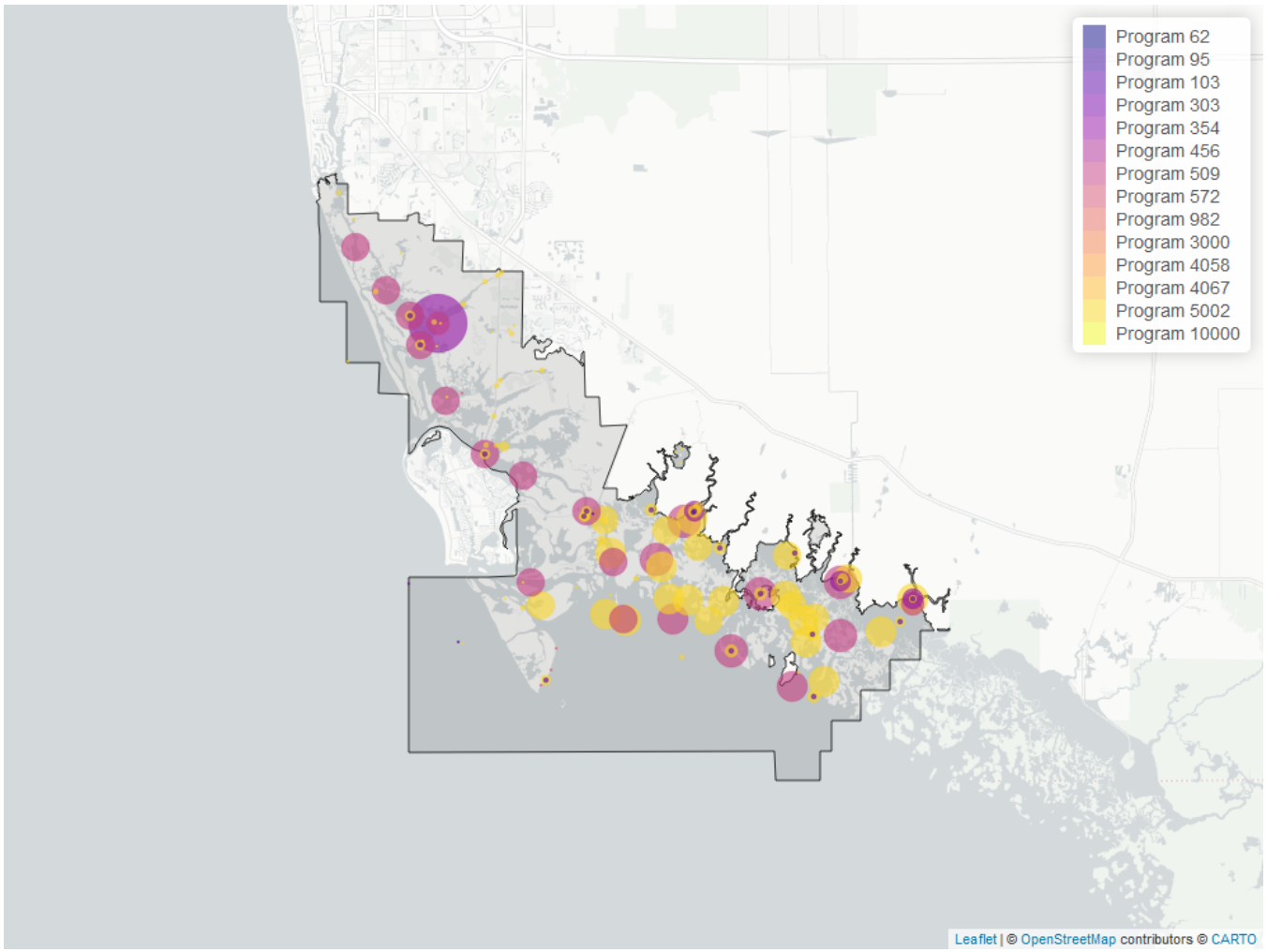

Figure 24: Map showing location of Discrete sampling sites for Turbidity. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 29: Programs contributing data for Turbidity

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	3638	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 Water Quality

Seasonal Kendall-Tau Trend Analysis

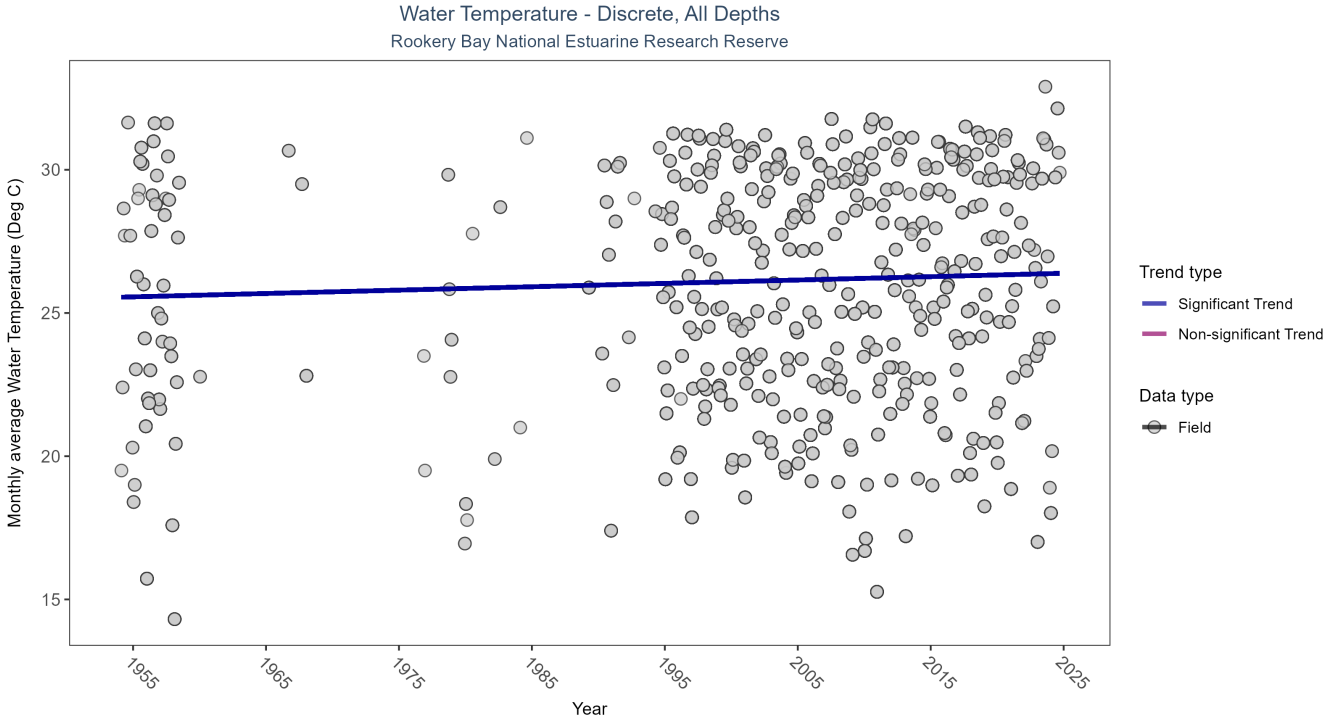

Figure 25: Seasonal Kendall-Tau Results for Water Temperature - Discrete

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

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	16837	50	26.64	TRUE	0.1001	0.0029	0.0118	25.5512	9.733	0.5546	1

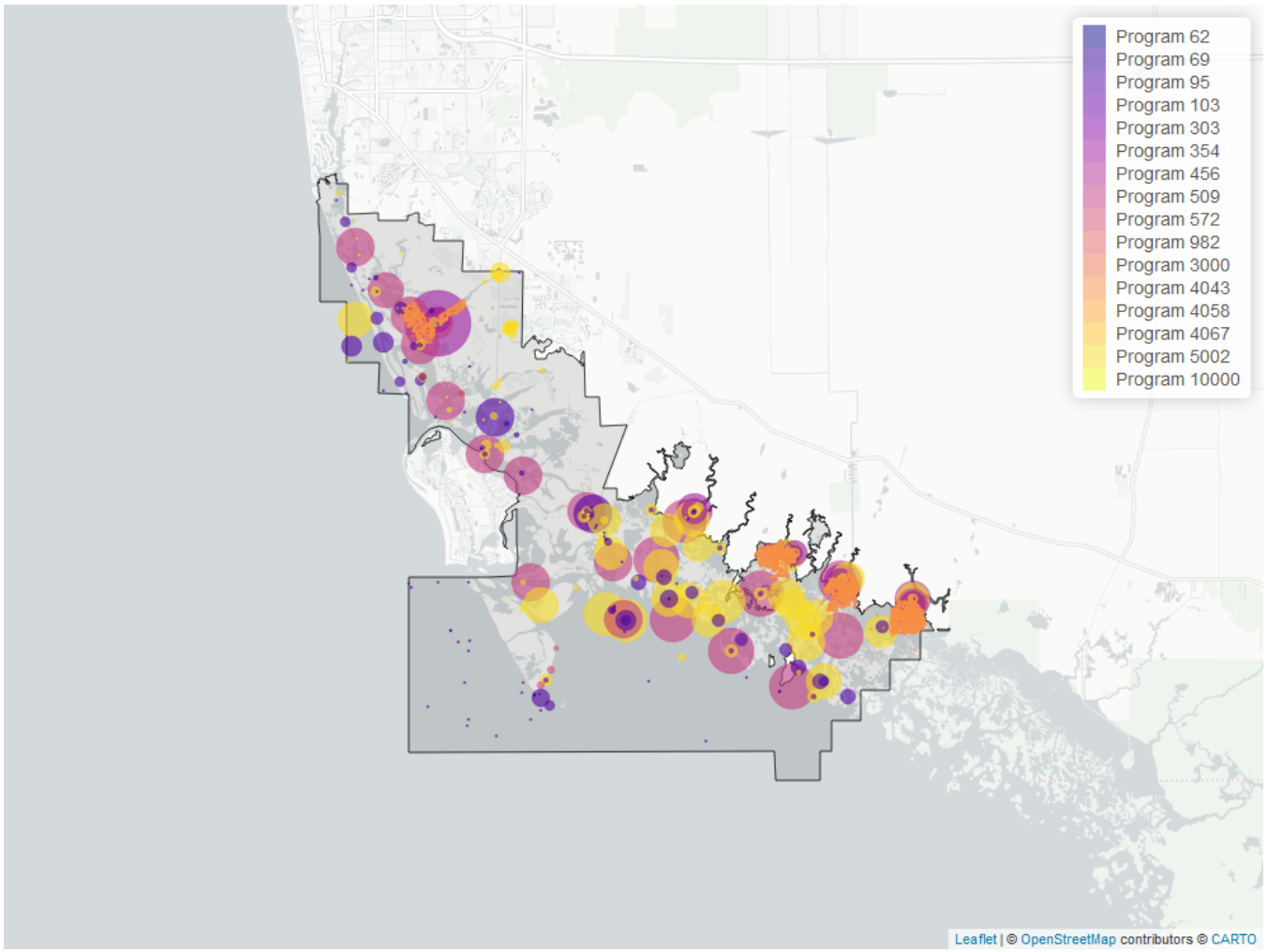

Figure 26: Map showing location of Discrete sampling sites for Water Temperature. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 31: Programs contributing data for Water Temperature

ProgramID	*N_Data*	*YearMin*	*YearMax*
5002	5640	1989	2024
509	5387	1994	2008
4043	3038	1999	2020
354	1756	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-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_cont_Dissolved_Oxygen_Saturation_SW-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_cont_pH_SW-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_cont_Salinity_SW-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_cont_Turbidity_SW-2024-Dec-08.txt*
- *Combined_WQ_WC_NUT_cont_Water_Temperature_SW-2024-Dec-08.txt*

Continuous monitoring locations in Rookery Bay National Estuarine Research Reserve

Table 32: Rookery Bay National Estuarine Research Reserve System-Wide Monitoring Program (354)

ProgramLocationID	*Years of Data*	*Use in Analysis*	*Parameters*
rkbbmwq	2	FALSE	DO , DOS , pH , Sal , Turb , TempW
rkbfbwq	23	TRUE	DO , DOS , pH , Sal , Turb , TempW
rkbfuwq	23	TRUE	DO , DOS , pH , Sal , Turb , TempW
rkblhwq	24	TRUE	DO , DOS , pH , Sal , Turb , TempW
rkbmbwq	25	TRUE	DO , DOS , pH , Sal , Turb , TempW
rkbpbwq	9	TRUE	DO , DOS , pH , Sal , Turb , TempW
rkbuhwq	5	TRUE	DO , DOS , pH , Sal , Turb , TempW

Table 33: National Water Information System (7)

ProgramLocationID	*Years of Data*	*Use in Analysis*	*Parameters*
02291330	4	FALSE	Sal , TempW
255123081321300	11	TRUE	Sal , TempW
255138081321701	8	TRUE	Sal , TempW
255432081303900	19	TRUE	Sal , TempW
255443081314700	5	FALSE	Sal , TempW
255532081314300	3	FALSE	Sal , TempW
255534081324000	18	TRUE	Sal , TempW
255654081350200	18	TRUE	Sal , TempW
255732081363700	5	TRUE	Sal , TempW

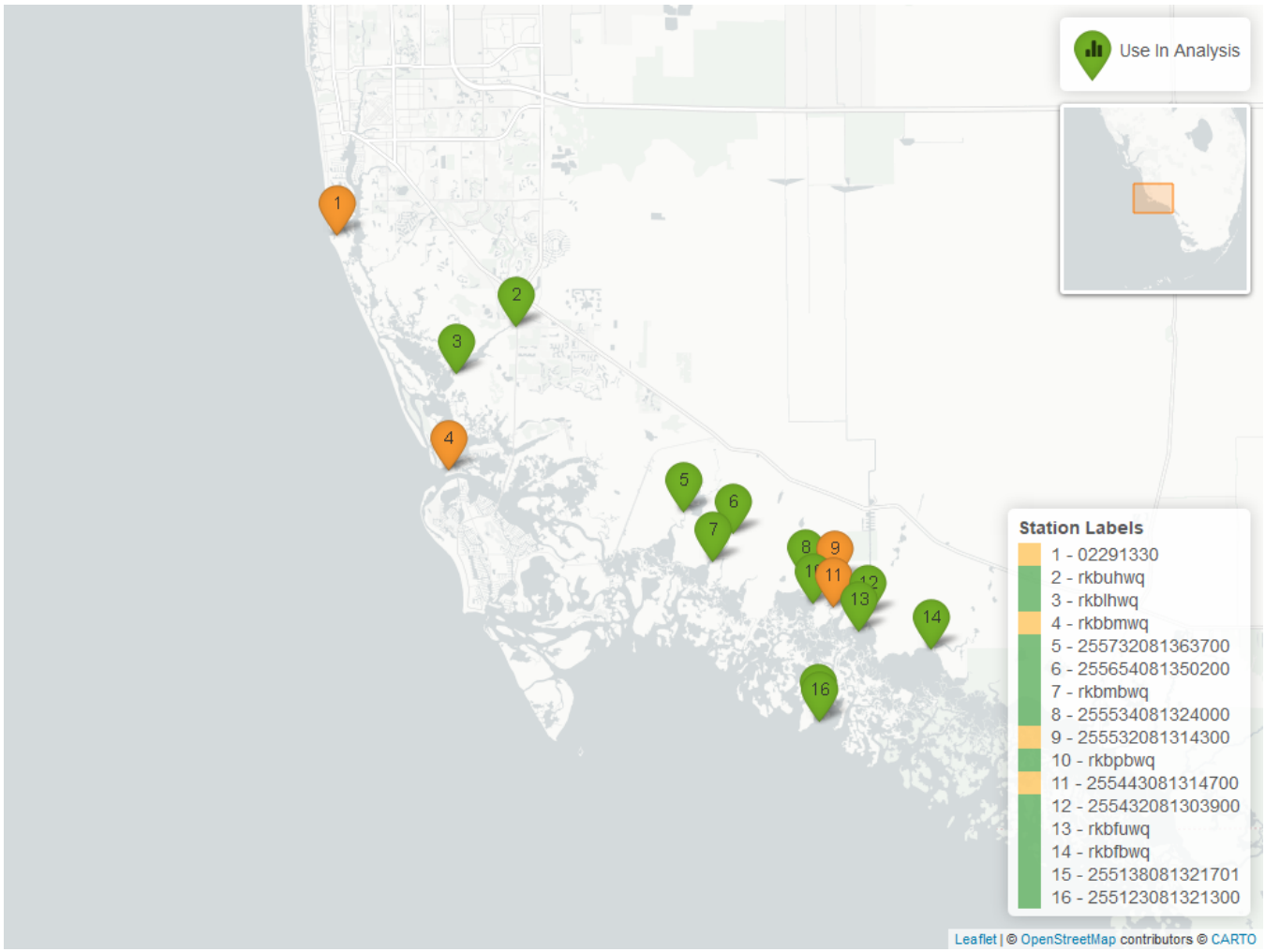

Figure 27: Map showing Continuous Water Quality Monitoring sampling locations within the boundaries of Rookery Bay National Estuarine Research Reserve. Sites marked as *Use In Analysis* are featured in this report.

Dissolved Oxygen - All Stations Combined

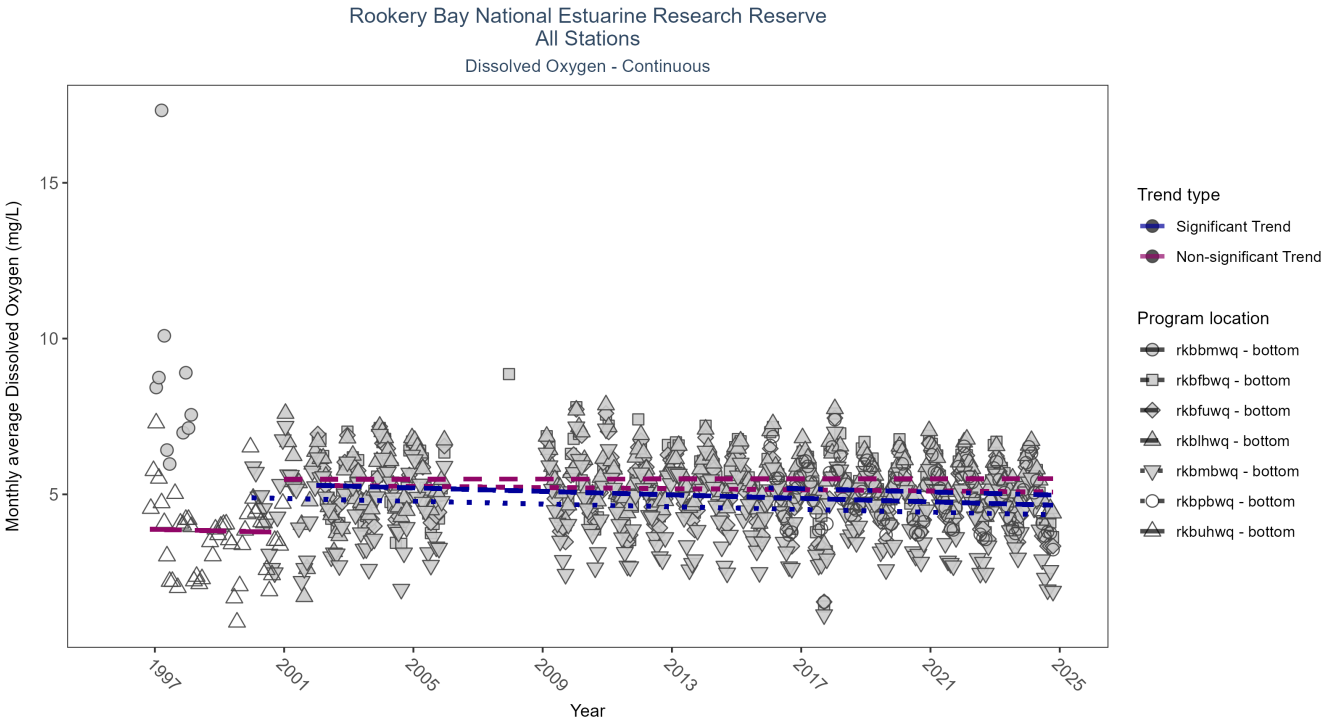

Figure 28: Figure for Dissolved Oxygen - Continuous - All stations combined

Table 34: Seasonal Kendall-Tau Results for All Stations - Dissolved Oxygen

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
rkbbmwq	10441	2	1997 - 1998	7.2	-	-	-	-
rkbfbwq	559530	21	2002 - 2024	5.4	-0.08	5.28	-0.01	0.1032
rkbfuwq	594676	20	2002 - 2024	5.0	-0.33	5.29	-0.03	0.0000
rkblhwq	570691	21	2001 - 2024	5.5	0	5.48	0	0.8577
rkbmbwq	613238	22	2000 - 2024	4.4	-0.26	4.89	-0.02	0.0000
rkbpbwq	289726	9	2016 - 2024	4.9	-0.18	5.21	-0.03	0.0246
rkbuhwq	58164	5	1996 - 2000	3.6	0.01	3.9	-0.02	1.0000

Dissolved Oxygen Saturation - All Stations Combined

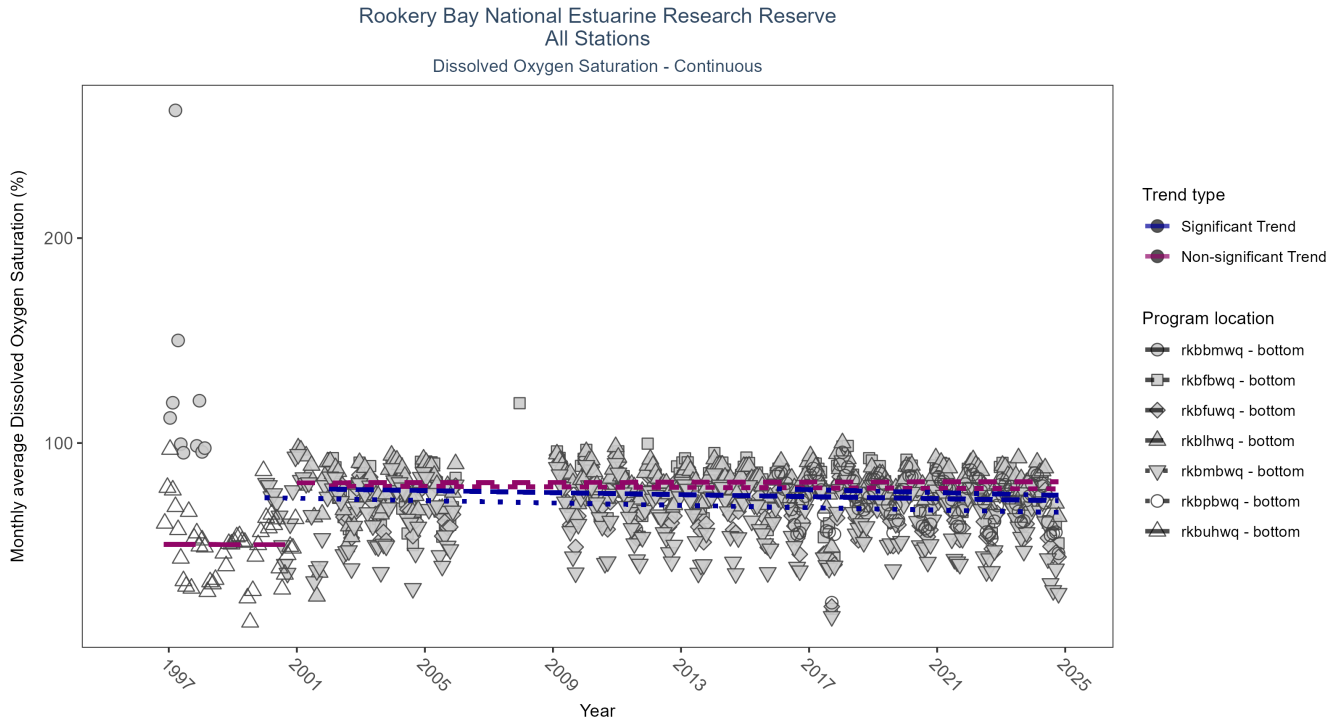

Figure 29: Figure for Dissolved Oxygen Saturation - Continuous - All stations combined

Table 35: Seasonal Kendall-Tau Results for All Stations - Dissolved Oxygen Saturation

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
rkbbmwq	10441	2	1997 - 1998	102.4	-	-	-	-
rkbfbwq	563836	21	2002 - 2024	78.3	-0.04	79.01	-0.06	0.4097
rkbfuwq	594935	20	2002 - 2024	72.2	-0.26	77.53	-0.25	0.0000
rkblhwq	583009	21	2001 - 2024	81.7	0.02	80.58	0.02	0.5540
rkbmbwq	619562	22	2000 - 2024	65.1	-0.23	73.35	-0.29	0.0000
rkbpbwq	291357	9	2016 - 2024	72.3	-0.18	77.6	-0.36	0.0289
rkbuhwq	58164	5	1996 - 2000	49.7	0	50.53	-0.02	1.0000

pH - All Stations Combined

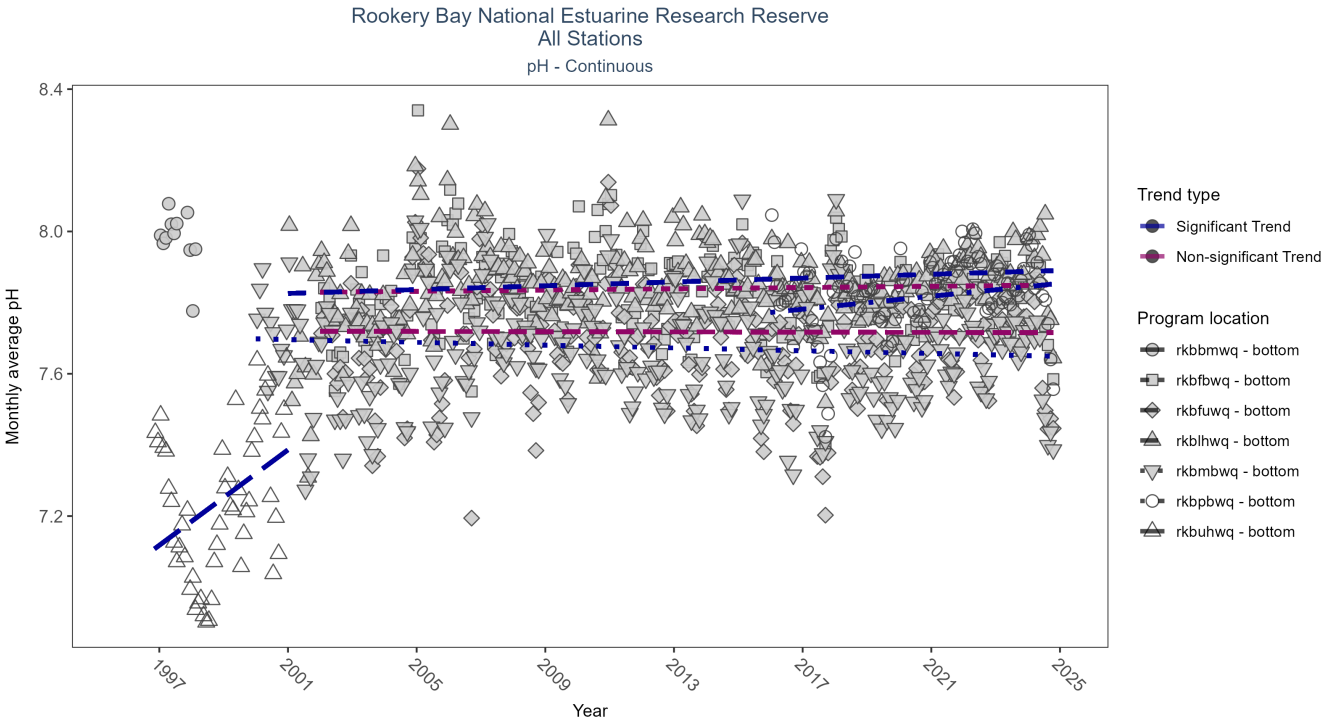

Figure 30: Figure for pH - Continuous - All stations combined

Table 36: Seasonal Kendall-Tau Results for All Stations - pH

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
rkbfbwq	626300	23	2002 - 2024	7.8	0.04	7.83	0	0.3005
rkbbmwq	12610	2	1997 - 1998	8.0	-	-	-	-
rkbfuwq	649975	23	2002 - 2024	7.7	-0.01	7.72	0	0.8449
rkblhwq	629829	24	2001 - 2024	7.9	0.14	7.83	0	0.0010
rkbmbwq	683502	25	2000 - 2024	7.7	-0.09	7.7	0	0.0346
rkbpbwq	283219	9	2016 - 2024	7.8	0.2	7.77	0.01	0.0176
rkbuhwq	65814	5	1996 - 2000	7.2	0.37	7.05	0.07	0.0081

Salinity - All Stations Combined by Program

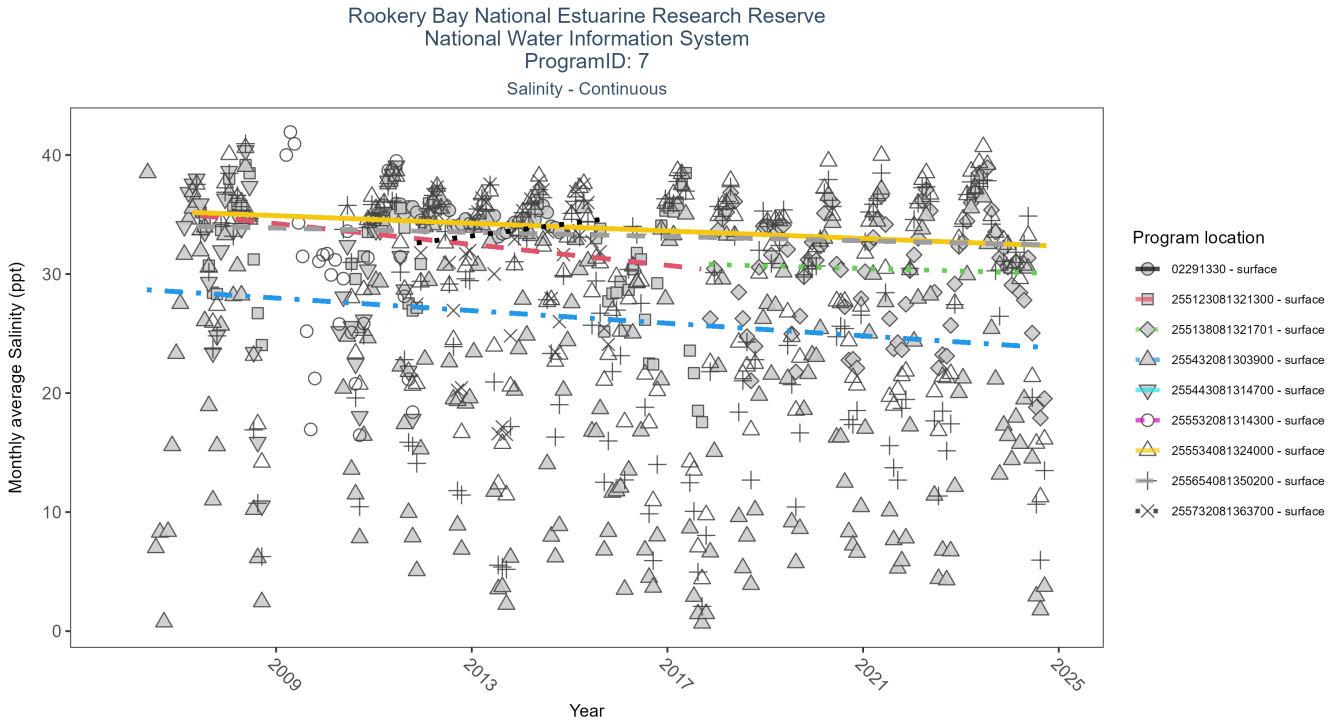

Figure 31: Figure for Salinity - Continuous - Program 7

Table 37: Seasonal Kendall-Tau Results for All Stations - Salinity

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
255654081350200	5674	17	2007 - 2024	32	-0.09	34.04	-0.09	0.0955
255732081363700	1434	5	2011 - 2015	34	0.25	32.15	0.52	0.0955
255532081314300	902	3	2009 - 2011	31	-	-	-	-
255534081324000	5677	17	2007 - 2024	32	-0.14	35.22	-0.16	0.0083
255432081303900	5961	18	2006 - 2024	21	-0.2	28.77	-0.26	0.0001
255138081321701	2482	8	2017 - 2024	31	-0.05	30.89	-0.11	0.5671
255123081321300	1809	8	2007 - 2017	32	-0.23	35.11	-0.44	0.0182
255443081314700	1465	4	2007 - 2011	32	-	-	-	-
02291330	1697	4	2011 - 2014	35	-	-	-	-

Salinity - All Stations Combined by Program

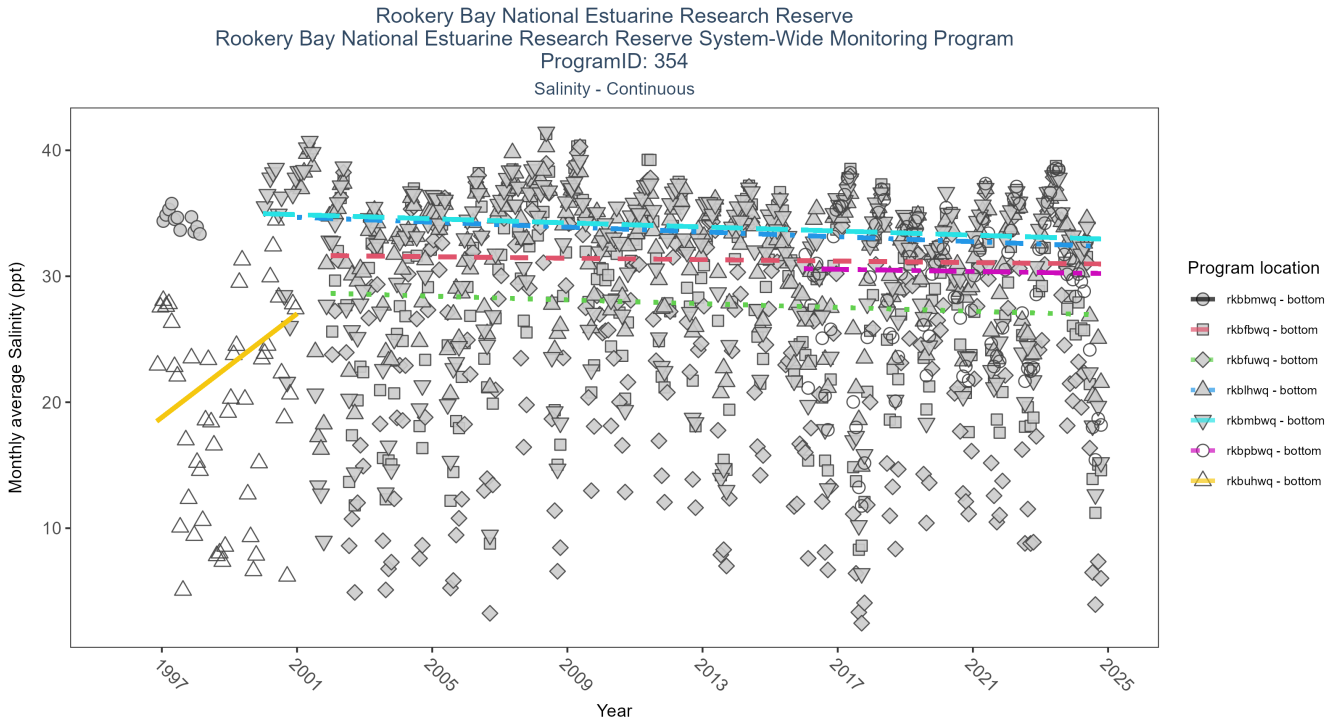

Figure 32: Figure for Salinity - Continuous - Program 354

Table 38: Seasonal Kendall-Tau Results for All Stations - Salinity

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
rkbfbwq	658798	23	2002 - 2024	29.6	-0.03	31.64	-0.03	0.4691
rkbbmwq	12256	2	1997 - 1998	34.5	-	-	-	-
rkbfuwq	675230	23	2002 - 2024	26.0	-0.07	28.65	-0.07	0.1290
rkblhwq	657842	24	2001 - 2024	33.1	-0.16	34.68	-0.1	0.0001
rkbmbwq	694825	25	2000 - 2024	33.3	-0.12	34.97	-0.08	0.0032
rkbpbwq	290041	9	2016 - 2024	30.2	-0.01	30.6	-0.04	0.9243
rkbuhwq	68446	5	1996 - 2000	21.1	0.31	16.74	2.06	0.0358

Turbidity - All Stations Combined

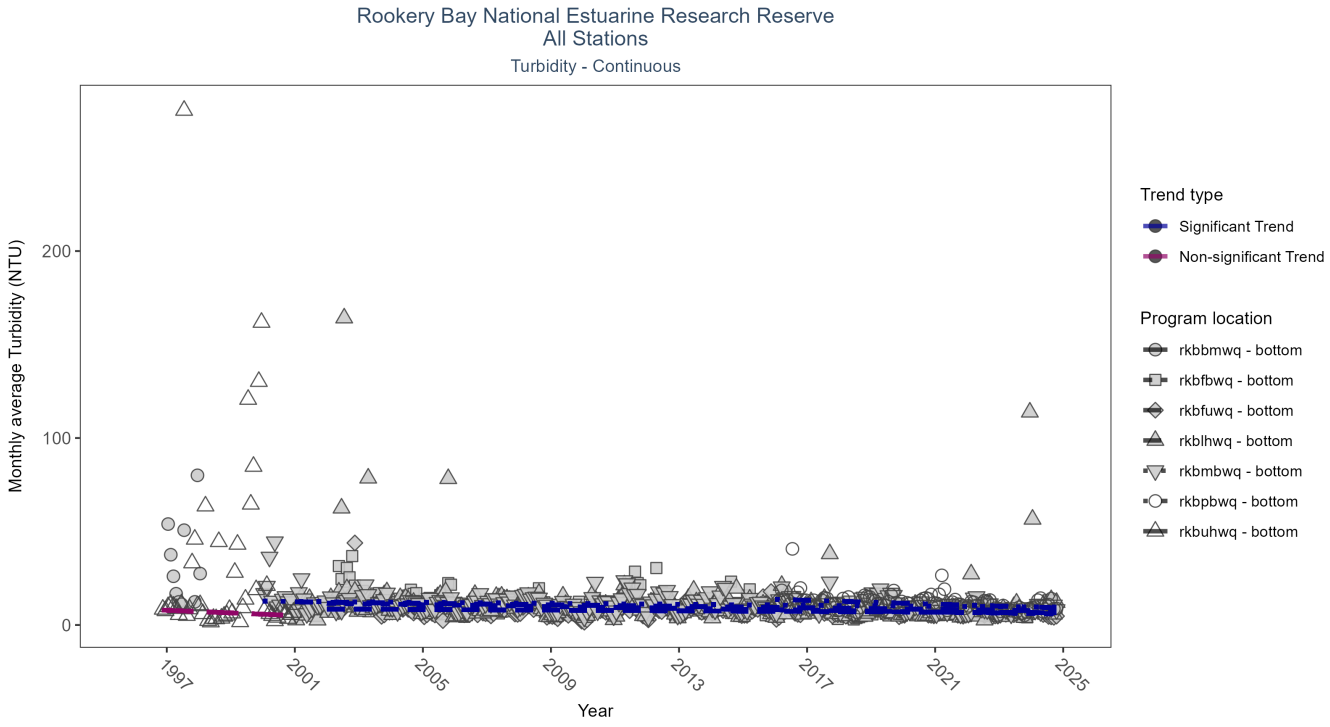

Figure 33: Figure for Turbidity - Continuous - All stations combined

Table 39: Seasonal Kendall-Tau Results for All Stations - Turbidity

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
rkbbmwq	10654	2	1997 - 1998	11	-	-	-	-
rkbfbwq	638544	23	2002 - 2024	7	-0.39	11.61	-0.25	0.0000
rkbfuwq	615945	23	2002 - 2024	6	-0.2	8.54	-0.09	0.0000
rkblhwq	605017	24	2001 - 2024	8	-0.27	12.4	-0.2	0.0000
rkbmbwq	670439	25	2000 - 2024	9	-0.22	12.74	-0.13	0.0000
rkbpbwq	286433	9	2016 - 2024	10	-0.37	13.71	-0.51	0.0000
rkbuhwq	61608	5	1996 - 2000	5	-0.11	8.57	-0.7	0.5228

Water Temperature - All Stations Combined by Program

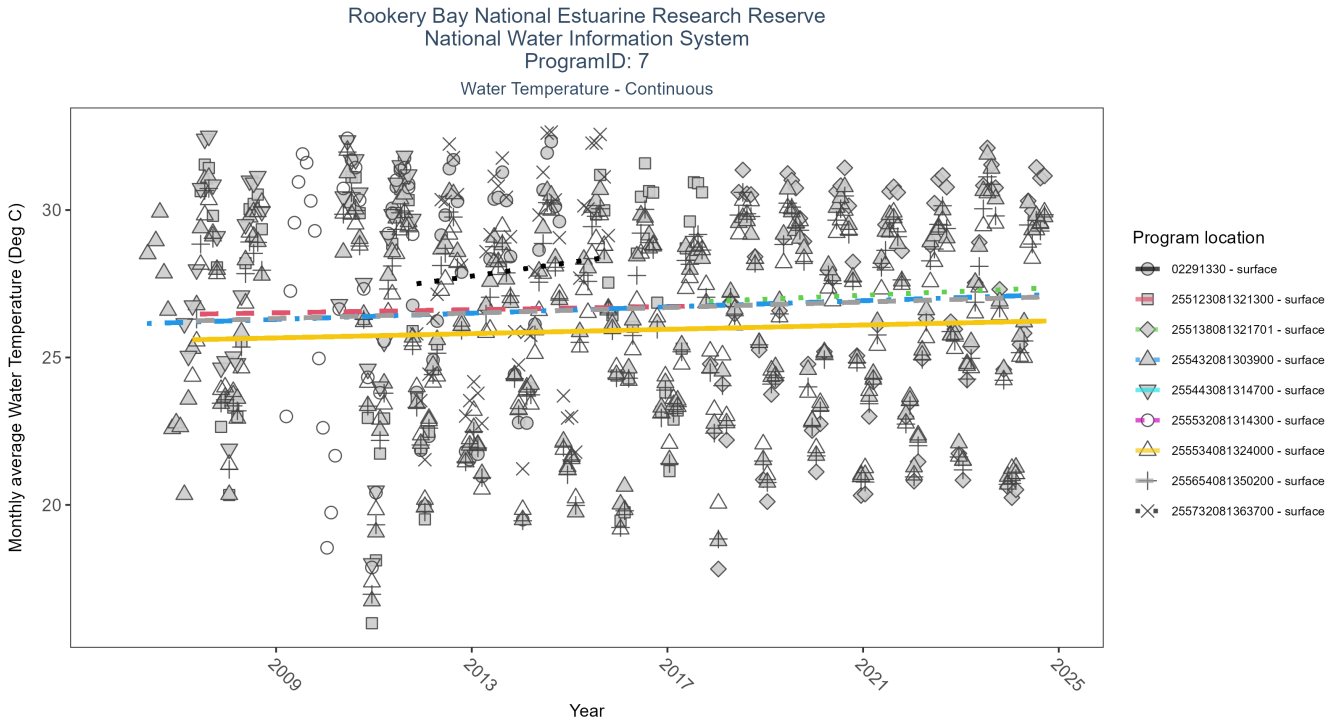

Figure 34: Figure for Water Temperature - Continuous - Program 7

Table 40: Seasonal Kendall-Tau Results for All Stations - Water Temperature

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
255654081350200	5712	17	2007 - 2024	26.9	0.15	26.23	0.05	0.0054
255123081321300	1818	8	2007 - 2017	27.3	0.1	26.46	0.03	0.3843
255432081303900	6019	18	2006 - 2024	27.1	0.17	26.13	0.05	0.0011
255534081324000	5733	17	2007 - 2024	26.7	0.14	25.59	0.04	0.0088
255443081314700	2011	4	2007 - 2011	29.3	-	-	-	-
255532081314300	906	3	2009 - 2011	29.3	-	-	-	-
255732081363700	1435	5	2011 - 2015	28.4	0.24	27.3	0.23	0.1149
255138081321701	2498	8	2017 - 2024	27.3	0.12	26.85	0.07	0.1723
02291330	1901	4	2011 - 2014	28.3	-	-	-	-

Water Temperature - All Stations Combined by Program

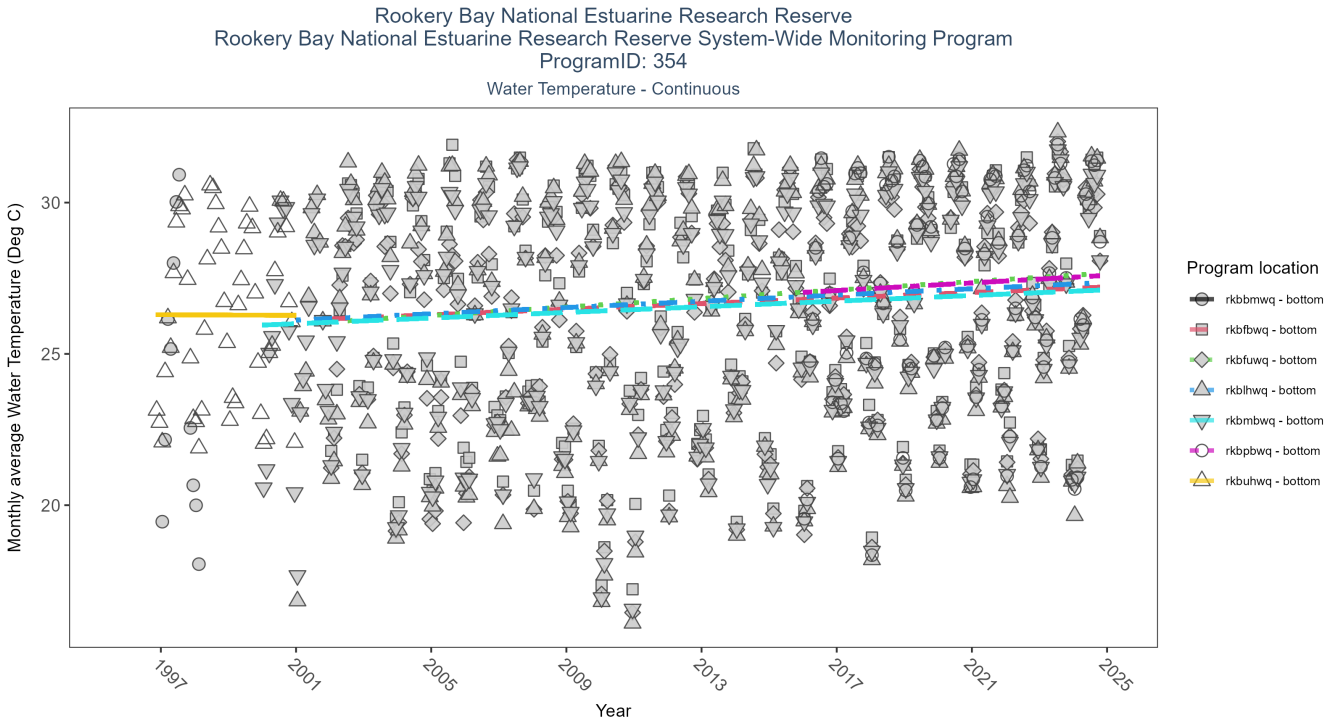

Figure 35: Figure for Water Temperature - Continuous - Program 354

Table 41: Seasonal Kendall-Tau Results for All Stations - Water Temperature

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
rkbbmwq	12610	2	1997 - 1998	23.8	-	-	-	-
rkbfbwq	674632	23	2002 - 2024	27.1	0.24	26.15	0.05	0.0000
rkbfuwq	685661	23	2002 - 2024	27.0	0.27	26.06	0.07	0.0000
rkblhwq	688994	24	2001 - 2024	27.0	0.25	26.12	0.05	0.0000
rkbmbwq	718152	25	2000 - 2024	26.9	0.26	25.95	0.05	0.0000
rkbpbwq	292925	9	2016 - 2024	27.6	0.14	27.03	0.06	0.0711
rkbuhwq	68971	5	1996 - 2000	26.8	-0.01	26.3	-0.01	1.0000

Submerged Aquatic Vegetation

The data file used is: **All_SAV_Parameters-2024-Dec-08.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

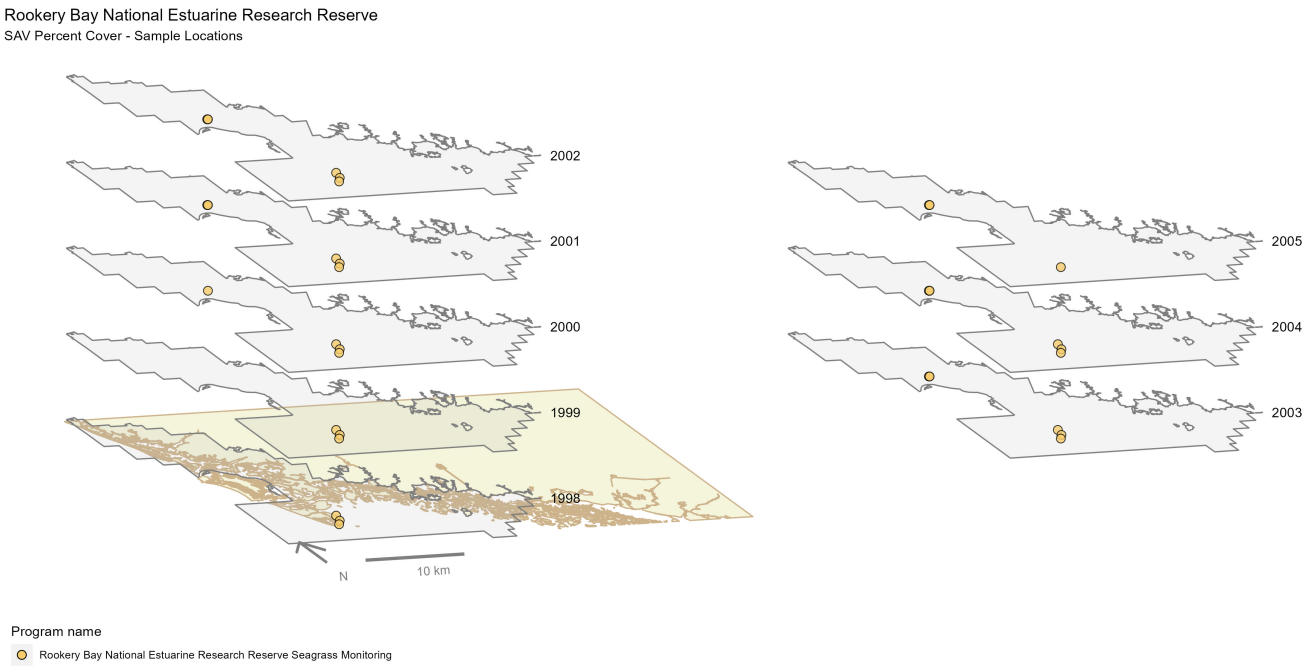

Figure 36: Maps showing the temporal scope of SAV sampling sites within the boundaries of *Rookery Bay National Estuarine Research Reserve* by Program name.

Sampling locations by Program:

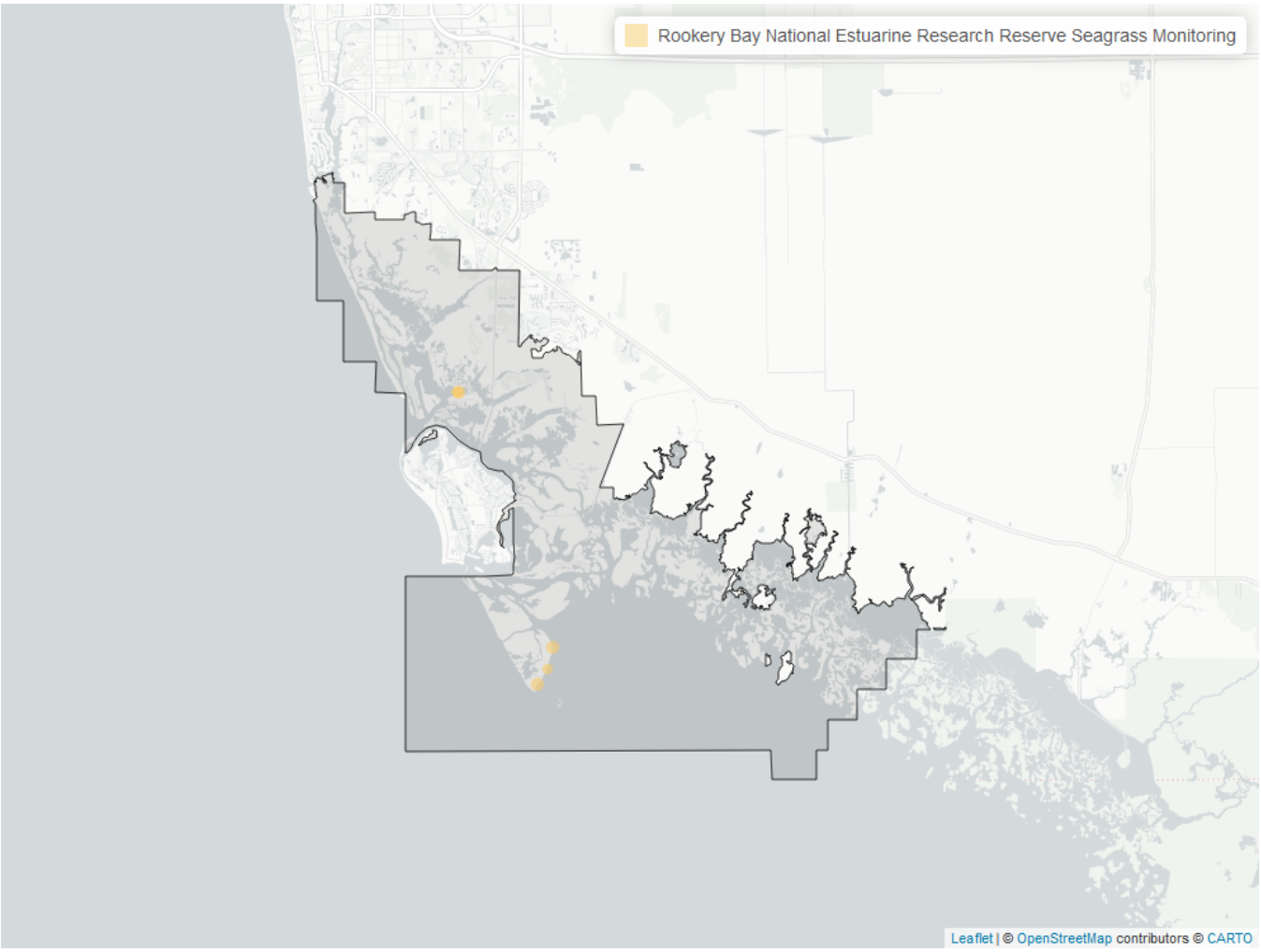

Figure 37: Map showing SAV sampling sites within the boundaries of *Rookery Bay National Estuarine Research Reserve*. The point size reflects the number of samples at a given sampling site.

Table 42: Rookery Bay National Estuarine Research Reserve Seagrass Monitoring - Program 572

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

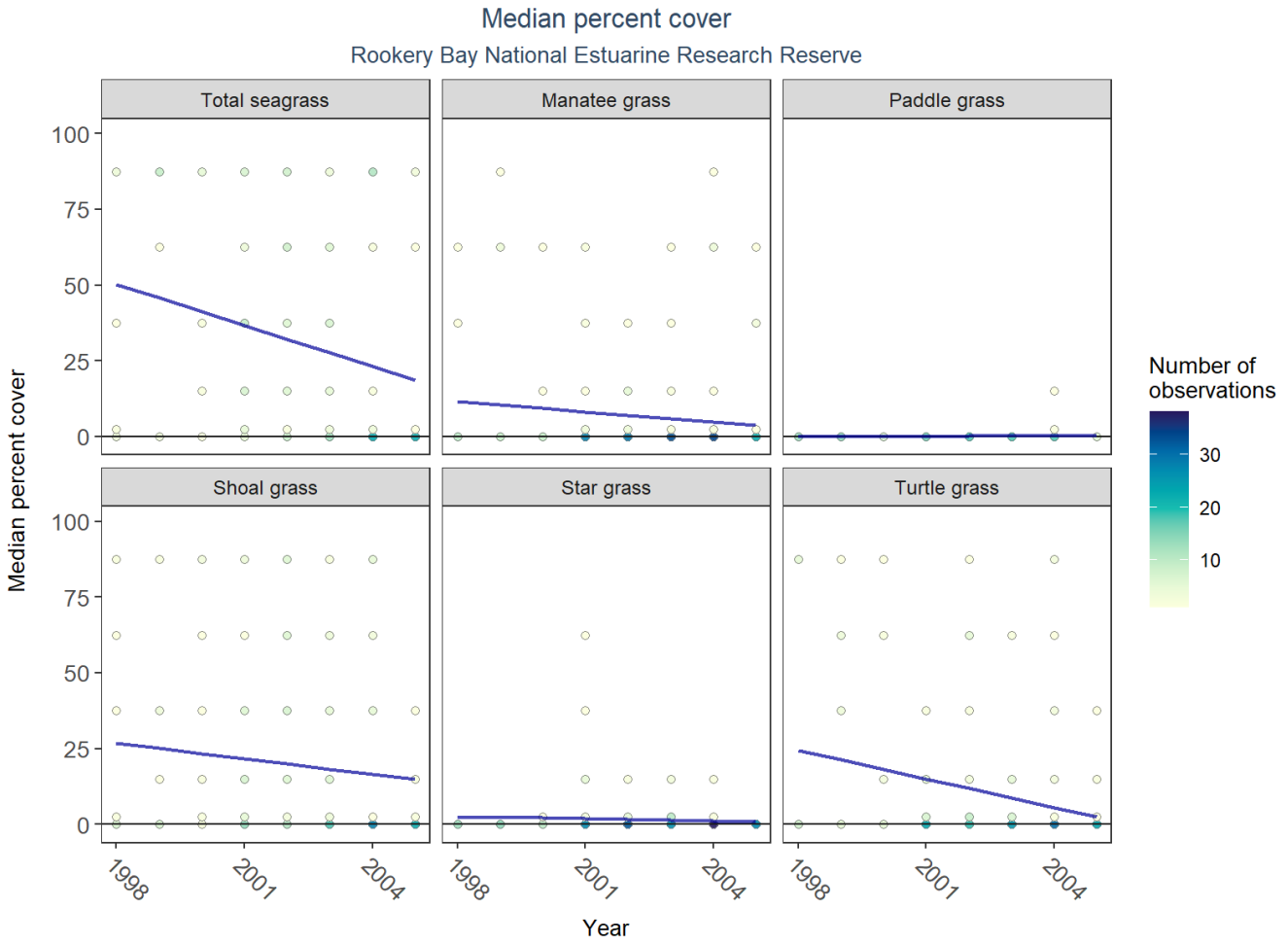

Figure 38: Trends in median percent cover for various seagrass species in Rookery Bay National Estuarine Research Reserve

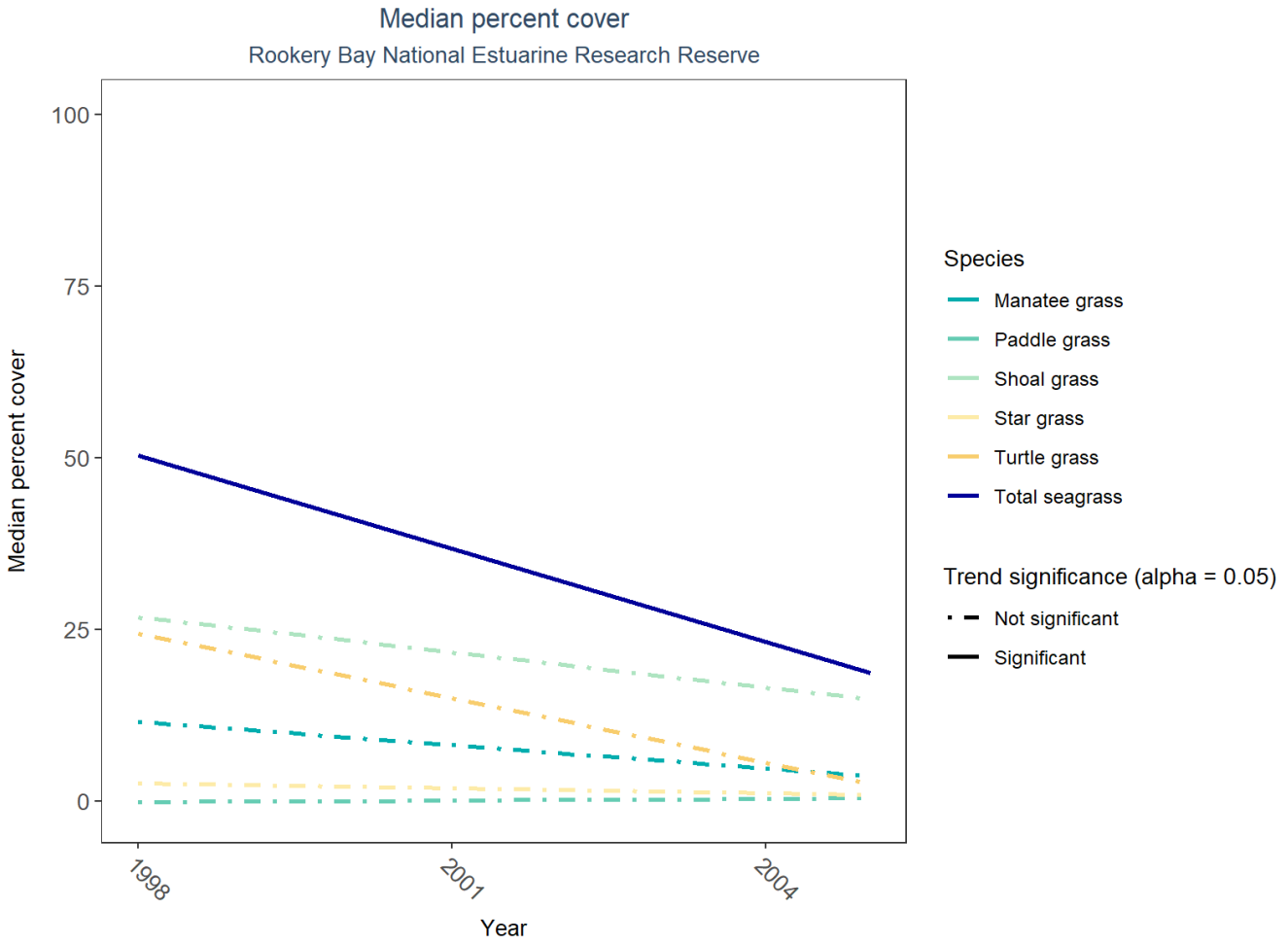

Figure 39: Trends in median percent cover for various seagrass species in Rookery Bay National Estuarine Research Reserve - simplified

Table 43: 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	33.6290543	-1.7091421	0.2545760
Paddle grass	No significant trend	1998 - 2005	-0.4445625	0.0784243	0.3562890
Star grass	No significant trend	1998 - 2005	3.5304851	-0.2323275	0.4437167
Manatee grass	No significant trend	1998 - 2005	16.1047796	-1.1343836	0.4000748
Turtle grass	No significant trend	1998 - 2005	36.9898877	-3.1381290	0.0666630
Total seagrass	Significantly decreasing trend	1998 - 2005	68.3693244	-4.5209502	0.0166204

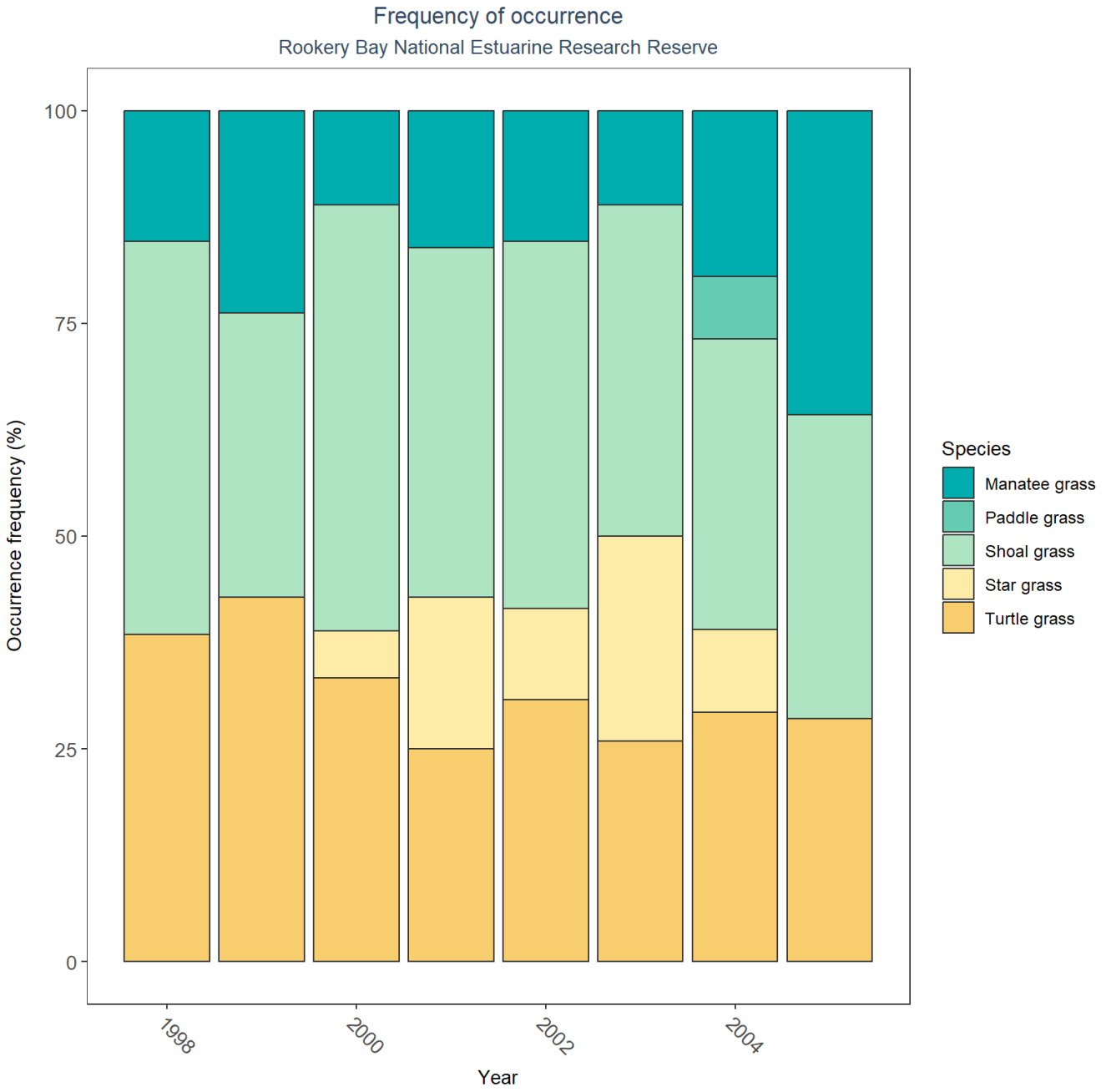

Figure 40: Frequency of occurrence for various seagrass species in Rookery Bay National Estuarine Research Reserve

Nekton

The data file used is: **All_NEKTON_Parameters-2024-Dec-17.txt**

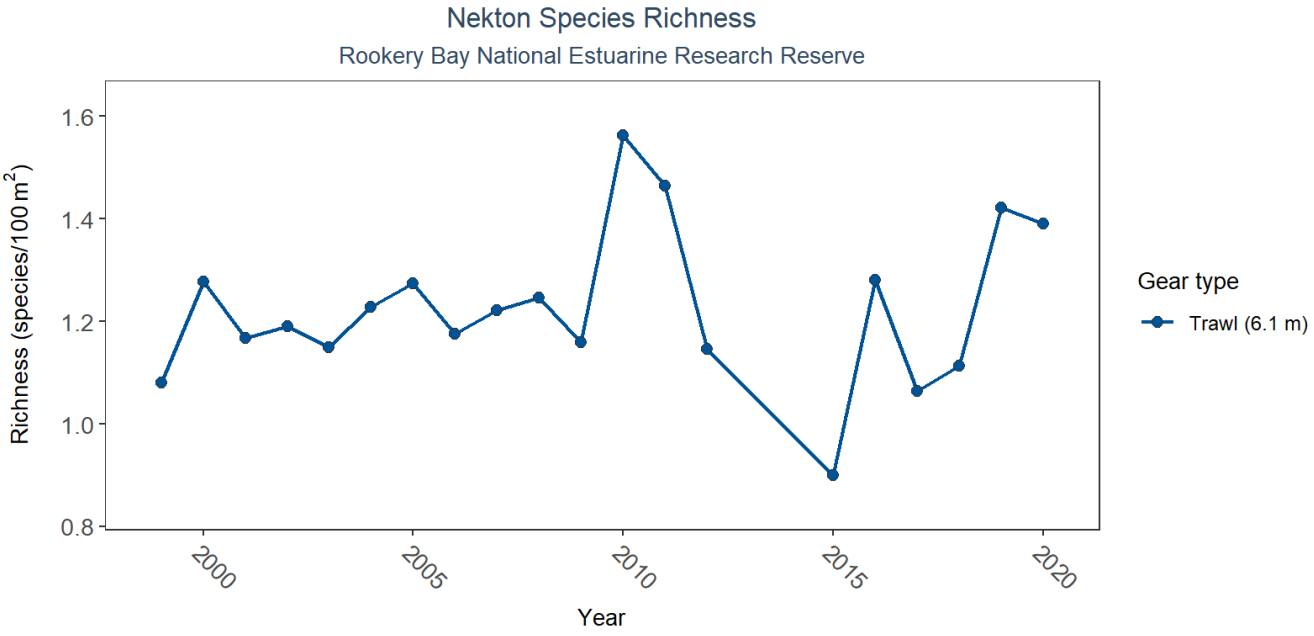

Figure 41: Figure for Nekton Species Richness in Rookery Bay National Estuarine Research Reserve

Table 44: Nekton Species Richness

Gear Type	*Sample Count*	*Number of Years*	*Period of Record*	*Median N of Taxa*	*Mean N of Taxa*
Trawl (6.1)	3098	20	1999 - 2020	1.21	1.24

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