

# Rookery Bay Aquatic Preserve

## SEACAR Habitat Analyses

Last compiled on 08 January, 2025

### Contents

<b>Funding &amp; Acknowledgements</b>	<b>2</b>
<b>Threshold Filtering</b>	<b>2</b>
<b>Value Qualifiers</b>	<b>3</b>
<b>Water Column</b>	<b>5</b>
<b>Seasonal Kendall-Tau Analysis</b>	<b>5</b>
<b>Water Quality - Discrete</b>	<b>5</b>
Chlorophyll a, Corrected for Pheophytin - Discrete Water Quality . . . . .	6
Chlorophyll a, Uncorrected for Pheophytin - Discrete Water Quality . . . . .	7
Colored Dissolved Organic Matter - Discrete Water Quality . . . . .	10
Dissolved Oxygen - Discrete Water Quality . . . . .	11
Dissolved Oxygen Saturation - Discrete Water Quality . . . . .	14
pH - Discrete Water Quality . . . . .	15
Salinity - Discrete Water Quality . . . . .	18
Secchi Depth - Discrete Water Quality . . . . .	20
Total Nitrogen - Discrete Water Quality . . . . .	21
Total Phosphorus - Discrete Water Quality . . . . .	24
Total Suspended Solids - Discrete Water Quality . . . . .	27
Turbidity - Discrete Water Quality . . . . .	28
Water Temperature - Discrete Water Quality . . . . .	31
<b>Water Quality - Continuous</b>	<b>34</b>
Dissolved Oxygen - All Stations Combined . . . . .	36
Dissolved Oxygen Saturation - All Stations Combined . . . . .	37
pH - All Stations Combined . . . . .	38
Salinity - All Stations Combined . . . . .	39
Turbidity - All Stations Combined . . . . .	40
Water Temperature - All Stations Combined . . . . .	41
<b>Submerged Aquatic Vegetation</b>	<b>42</b>
Parameters . . . . .	42
Species . . . . .	42
Notes . . . . .	42
<b>Nekton</b>	<b>48</b>
<b>References</b>	<b>49</b>

## Funding & Acknowledgements

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

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## Threshold Filtering

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

Table 1: Continuous Water Quality threshold values

<i>Parameter Name</i>	<i>Units</i>	<i>Low Threshold</i>	<i>High Threshold</i>
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

<i>Parameter Name</i>	<i>Units</i>	<i>Low Threshold</i>	<i>High Threshold</i>
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	-	-

<i>Parameter Name</i>	<i>Units</i>	<i>Low Threshold</i>	<i>High Threshold</i>
Dissolved Oxygen	mg/L	-0.000001	25
Dissolved Oxygen Saturation	%	-0.000001	310
Fluorescent Dissolved Organic Matter	QSE	-	-
Light Extinction Coefficient	m <sup>-1</sup>	-	-
NO <sub>2</sub> + <sub>3</sub> , Filtered	mg/L	-	-
Nitrate (NO <sub>3</sub> )	mg/L	-	-
Nitrite (NO <sub>2</sub> )	mg/L	-	-
Nitrogen, organic	mg/L	-	-
Phosphate, Filtered (PO <sub>4</sub> )	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

<i>SEACAR QAQC Description</i>	<i>Include</i>	<i>SEACAR QAQCFlagCode</i>
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

<i>Qualifier Source</i>	<i>Value Qualifier</i>	<i>Include</i>	<i>MDL</i>	<i>Description</i>
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 determination; results may not be accurate. This code shall be used if a field screening test (e.g., field gas chromatograph data, immunoassay, or vendor-supplied field kit) was used to generate the value and the field kit or method has not been recognized by the Department as equivalent to laboratory methods.

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

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

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

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

**Systemwide Monitoring Program (SWMP) value qualifier codes**

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

Table 5: SWMP Value Qualifier codes

<i>Qualifier Source</i>	<i>Value Qualifier</i>	<i>Include</i>	<i>Description</i>
SWMP	-1	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, and water quality assessments of salinity, dissolved oxygen, pH, and water temperature. Water clarity is evaluated with Secchi depth, turbidity, levels of chlorophyll a, total suspended solids, and colored dissolved organic matter. Additionally, the richness of nekton is indicated by the abundance of free-swimming fishes and macroinvertebrates like crabs and shrimps.

## Seasonal Kendall-Tau Analysis

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

## Water Quality - Discrete

The following files were used in the discrete analysis:

- *Combined\_WQ\_WC\_NUT\_Chlorophyll\_a\_corrected\_for\_pheophytin-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

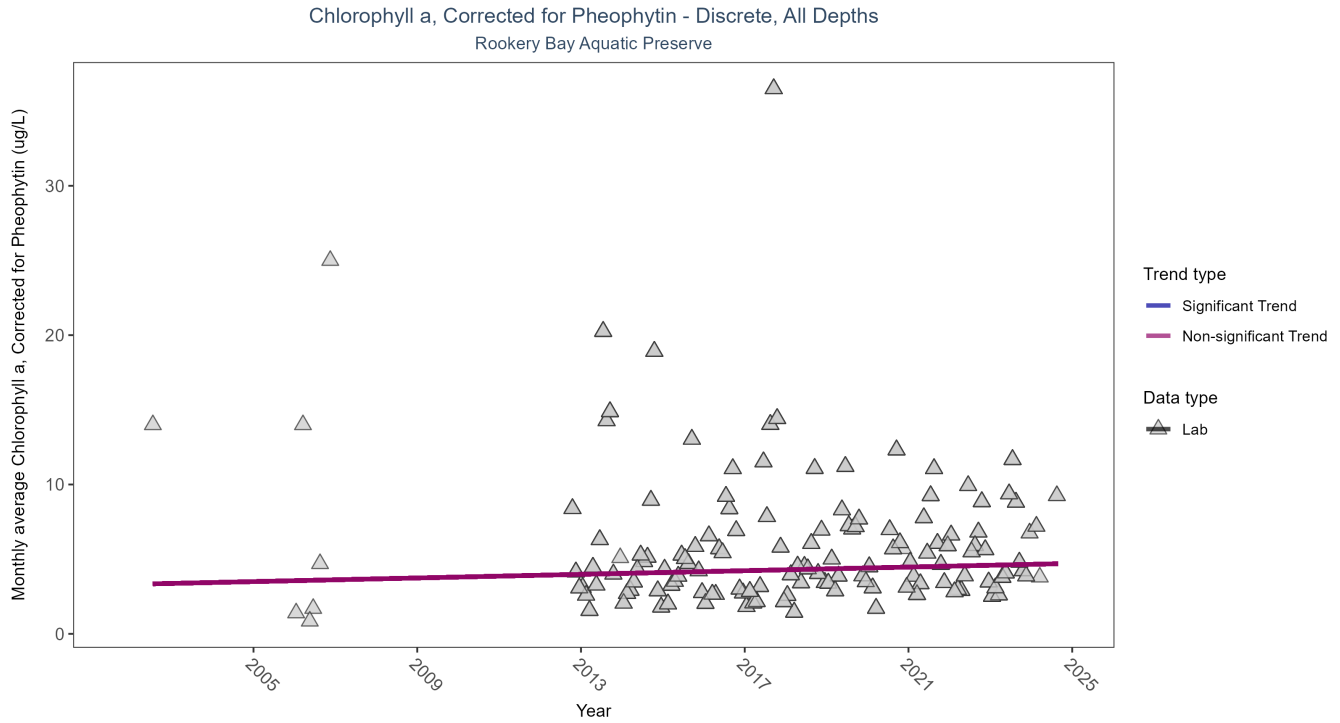


Figure 1: Seasonal Kendall-Tau Results for Chlorophyll a, Corrected for Pheophytin - Discrete

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	1546	15	4.2	TRUE	0.1077	0.0885	0.0608	3.3155	19.6307	0.0507	0

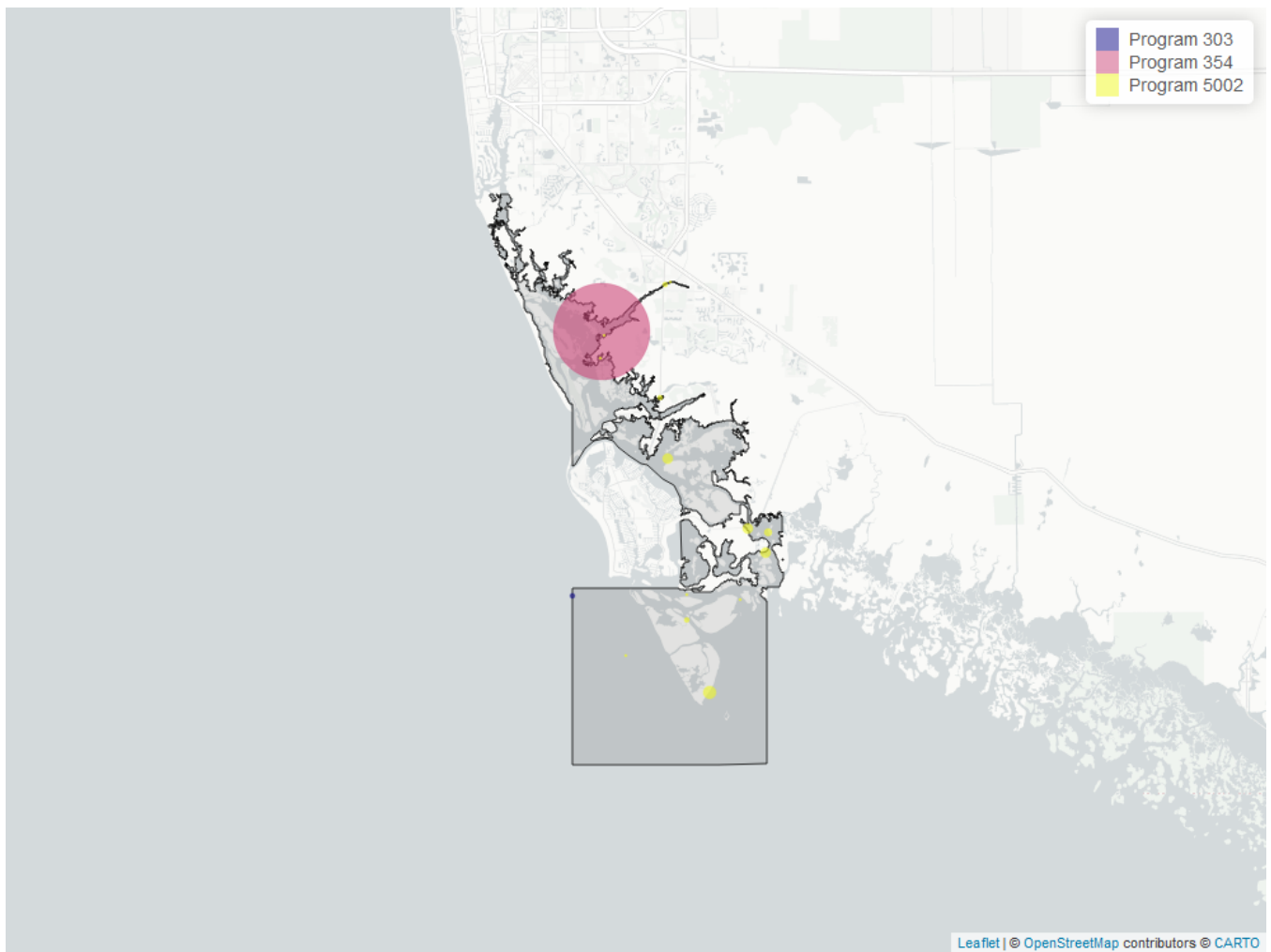


Figure 2: Map showing location of Discrete sampling sites for Chlorophyll a, Corrected for Pheophytin. The bubble size on the maps below reflect the amount of data available at each sampling site.

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

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
354	1464	2012	2024
5002	102	2002	2024
303	3	2022	2023

**Program names:**

*303* - River, Estuary and Coastal Observing Network<sup>1</sup>

*354* - Rookery Bay National Estuarine Research Reserve System-Wide Monitoring Program<sup>2</sup>

*5002* - Florida STORET / WIN<sup>3</sup>

**Chlorophyll a, Uncorrected for Pheophytin - Discrete Water Quality**

**Seasonal Kendall-Tau Trend Analysis**

Chlorophyll a, Uncorrected for Pheophytin - Discrete, All Depths  
Rookery Bay Aquatic Preserve

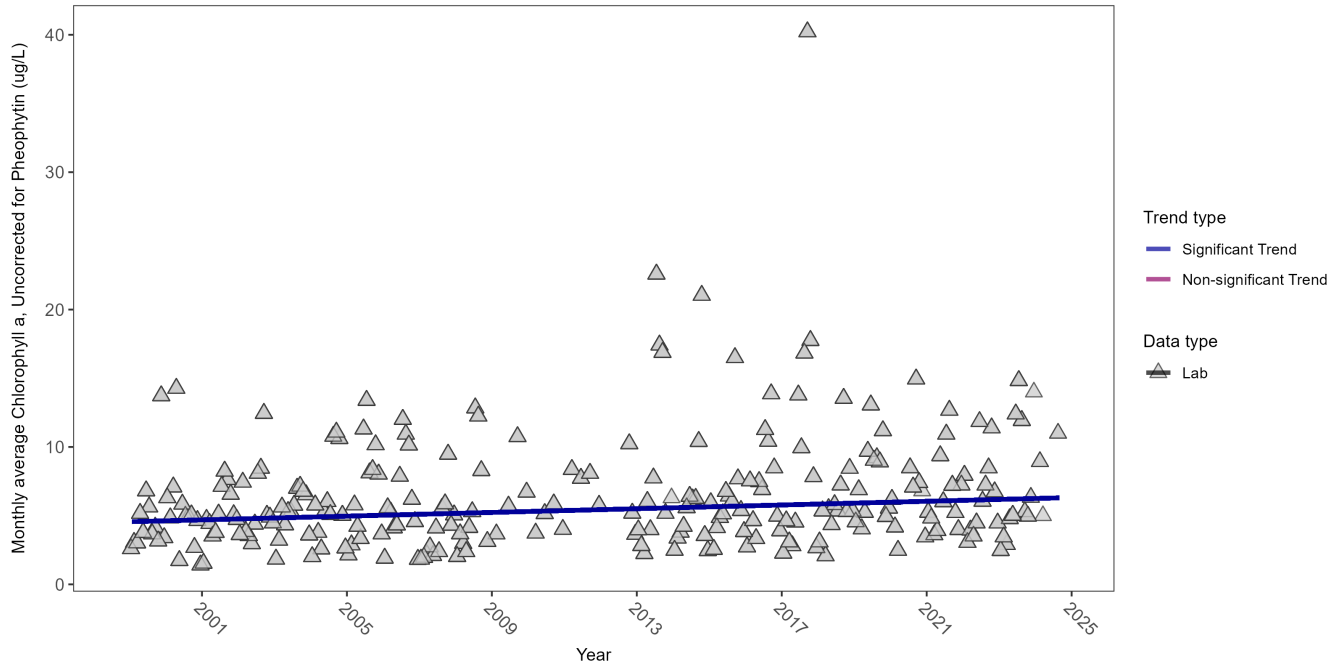


Figure 3: Seasonal Kendall-Tau Results for Chlorophyll a, Uncorrected for Pheophytin - Discrete

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	3141	26	5	TRUE	0.1899	0	0.0677	4.558	14.9735	0.1837	1



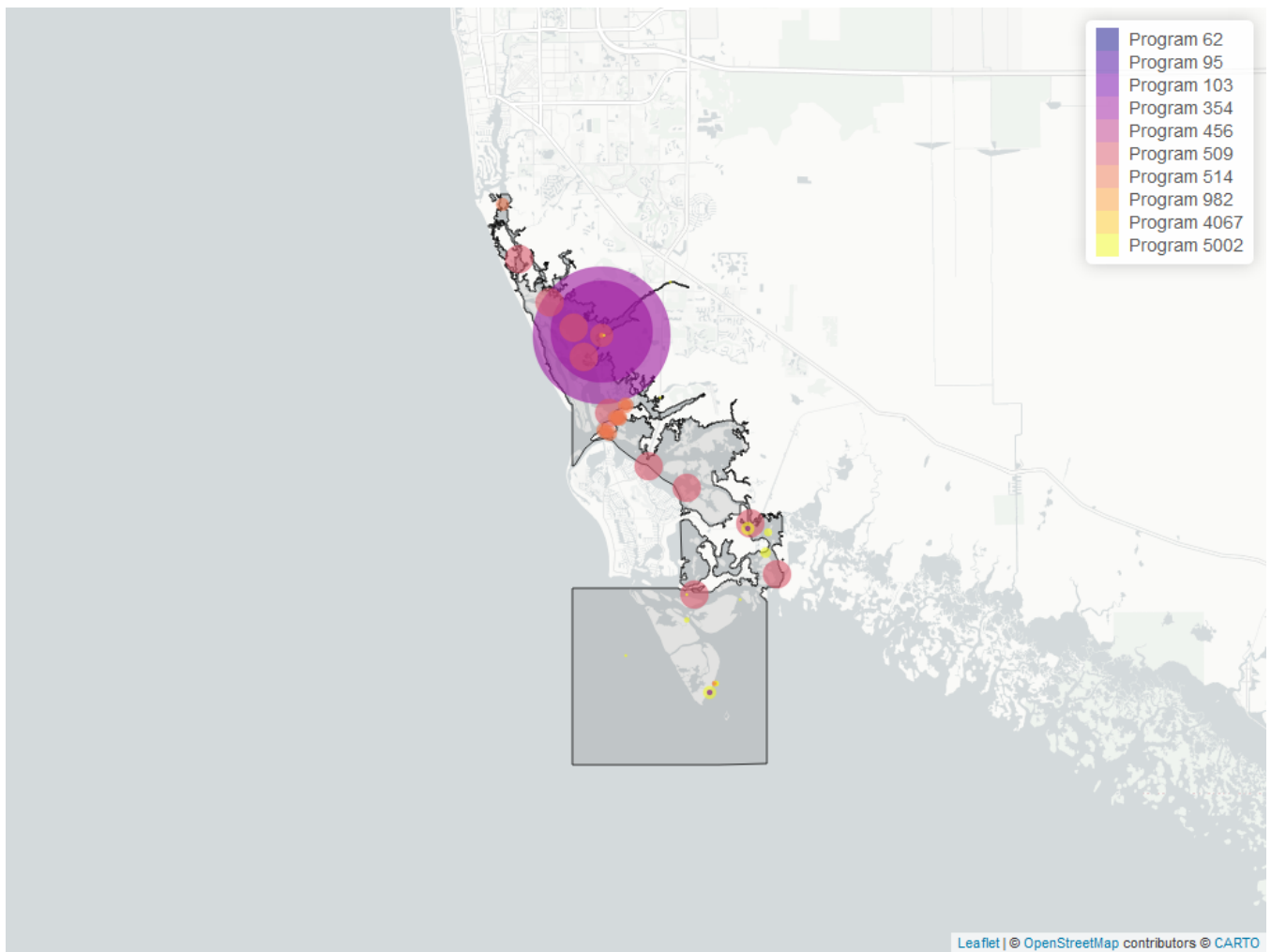


Figure 4: Map showing location of Discrete sampling sites for Chlorophyll a, Uncorrected for Pheophytin. The bubble size on the maps below reflect the amount of data available at each sampling site.

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

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
354	4475	2002	2024
509	1234	1999	2008
514	374	2001	2011
5002	99	2001	2024
103	11	2021	2021

**Program names:**

- 103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX<sup>4</sup>
- 354 - Rookery Bay National Estuarine Research Reserve System-Wide Monitoring Program<sup>2</sup>
- 509 - SERC Water Quality Monitoring Network<sup>5</sup>
- 514 - Florida LAKEWATCH Program<sup>6</sup>
- 5002 - Florida STORET / WIN<sup>3</sup>

# Colored Dissolved Organic Matter - Discrete Water Quality

## Seasonal Kendall-Tau Trend Analysis

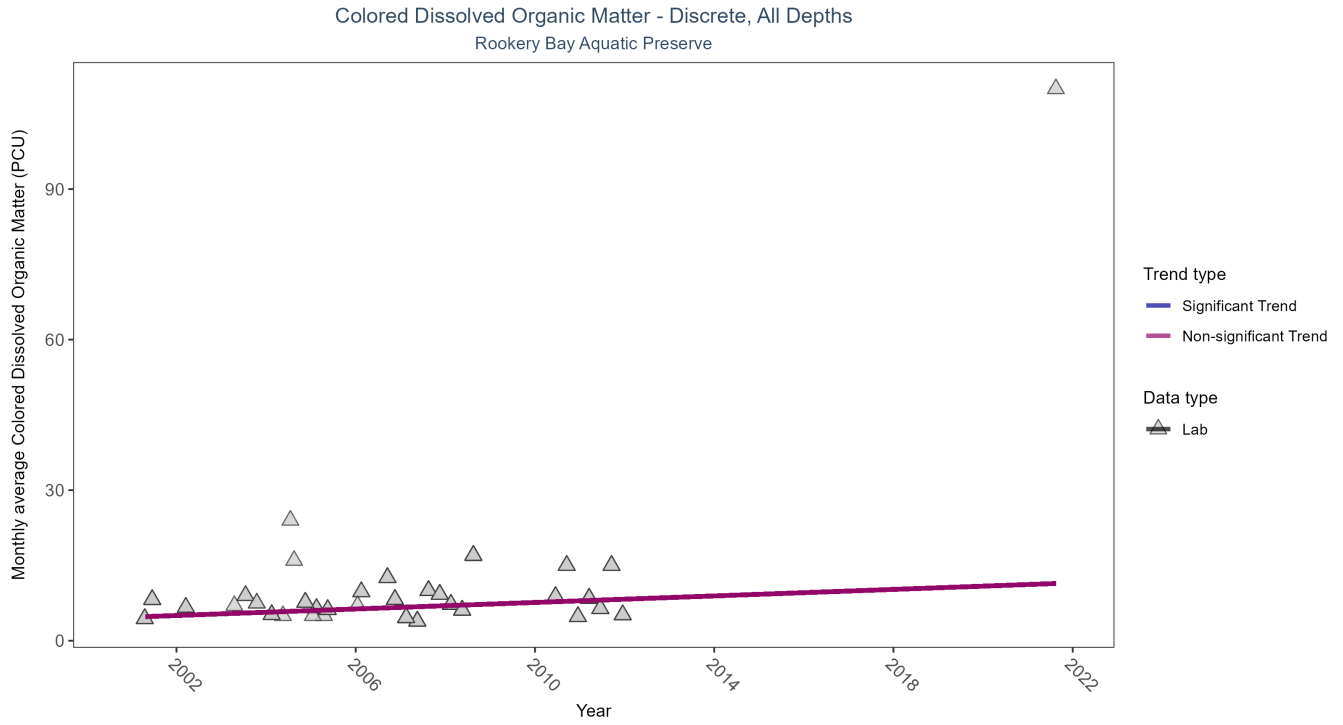


Figure 5: Seasonal Kendall-Tau Results for Colored Dissolved Organic Matter - Discrete

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	183	11	7	TRUE	0.5051	0.0515	0.325	4.7	3.7997	0.9559	0

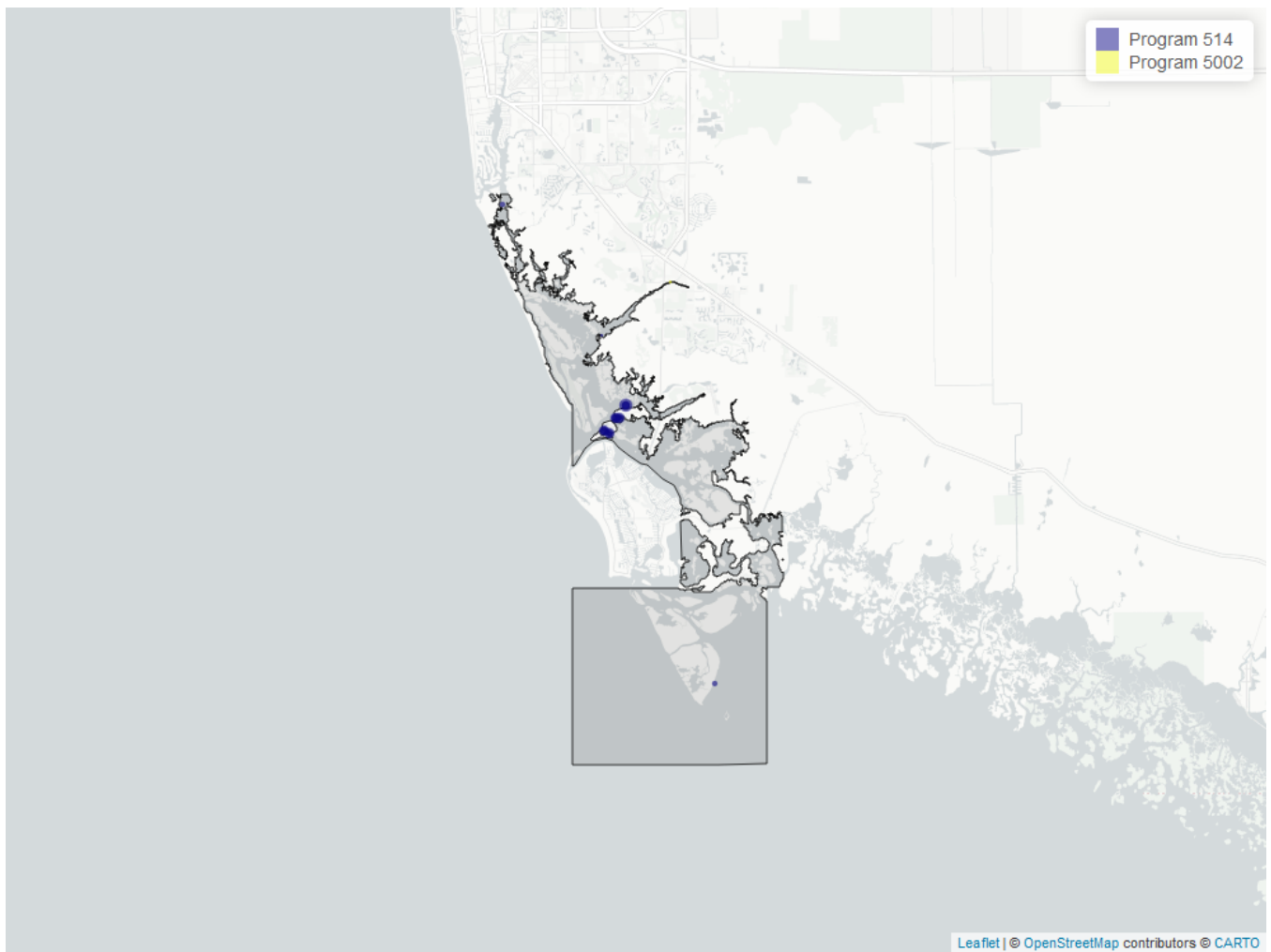


Figure 6: Map showing location of Discrete sampling sites for Colored Dissolved Organic Matter. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 11: Programs contributing data for Colored Dissolved Organic Matter

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
514	182	2001	2011
5002	1	2021	2021

**Program names:**

514 - Florida LAKEWATCH Program<sup>6</sup>

5002 - Florida STORET / WIN<sup>3</sup>

**Dissolved Oxygen - Discrete Water Quality**

**Seasonal Kendall-Tau Trend Analysis**

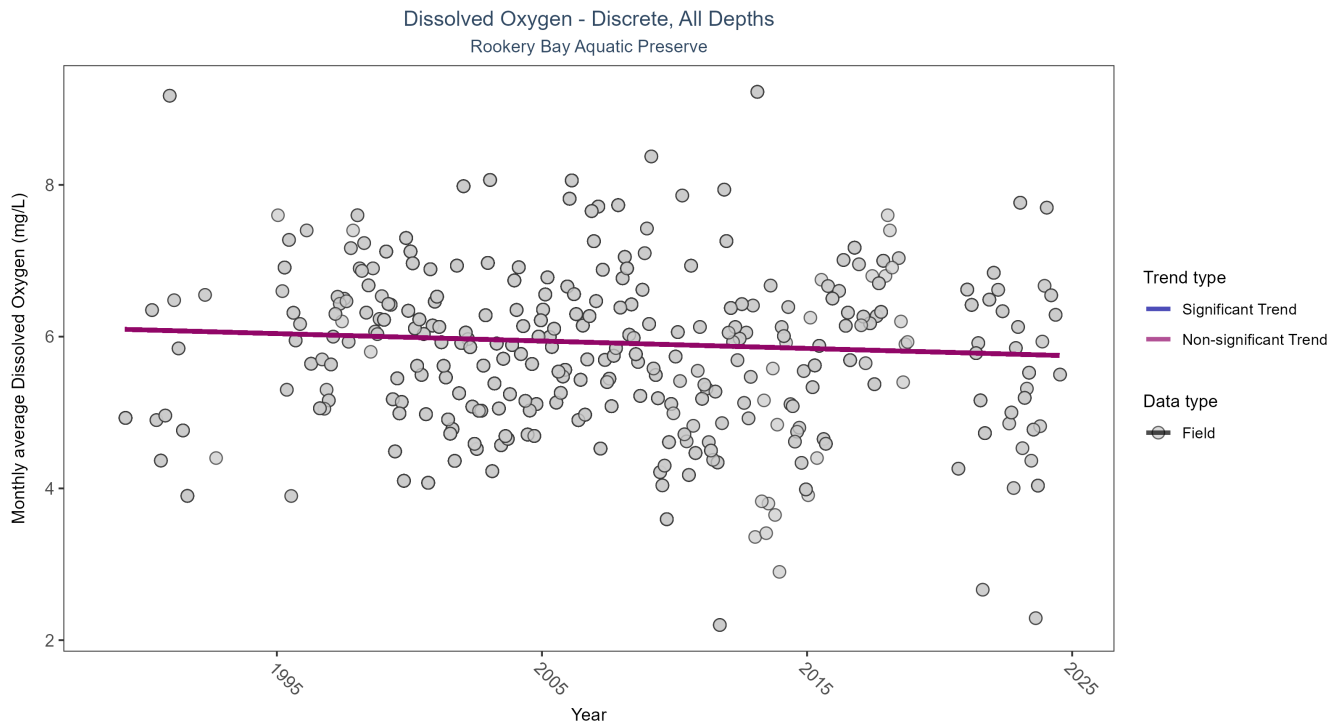


Figure 7: Seasonal Kendall-Tau Results for Dissolved Oxygen - Discrete

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	4538	33	5.83	TRUE	-0.0701	0.0815	-0.0098	6.0986	1.841	0.999	0

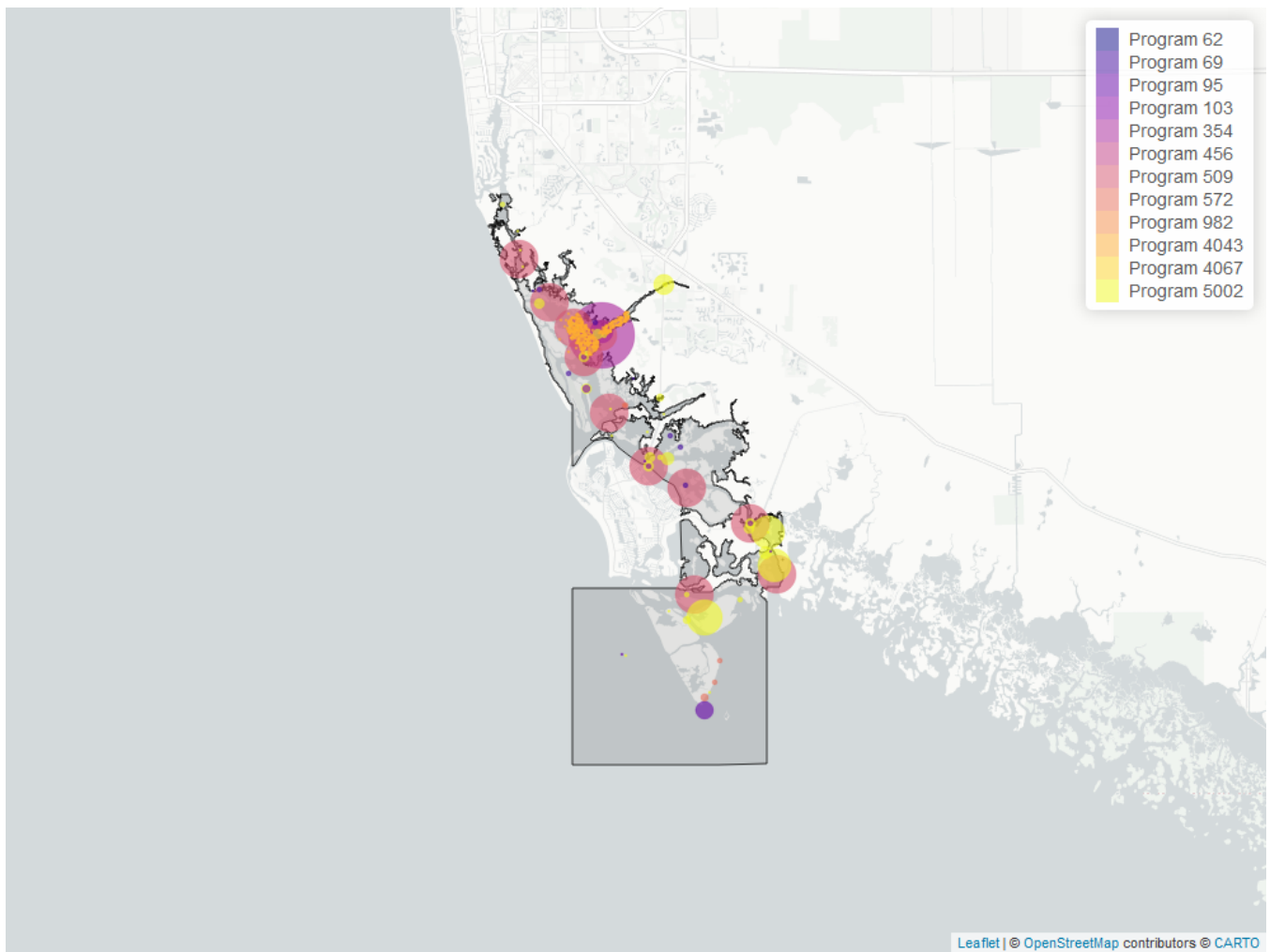


Figure 8: Map showing location of Discrete sampling sites for Dissolved Oxygen. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 13: Programs contributing data for Dissolved Oxygen

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
509	2429	1999	2008
5002	846	1989	2024
354	734	2002	2023
4043	488	2000	2009
95	51	1997	2018
103	32	2021	2021
572	27	1998	2005
69	22	2001	2001

**Program names:**

69 - Fisheries-Independent Monitoring (FIM) Program<sup>7</sup>

95 - Harmful Algal Bloom Marine Observation Network<sup>8</sup>

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX<sup>4</sup>

354 - Rookery Bay National Estuarine Research Reserve System-Wide Monitoring Program<sup>2</sup>

509 - SERC Water Quality Monitoring Network<sup>5</sup>

## Dissolved Oxygen Saturation - Discrete Water Quality

### Seasonal Kendall-Tau Trend Analysis

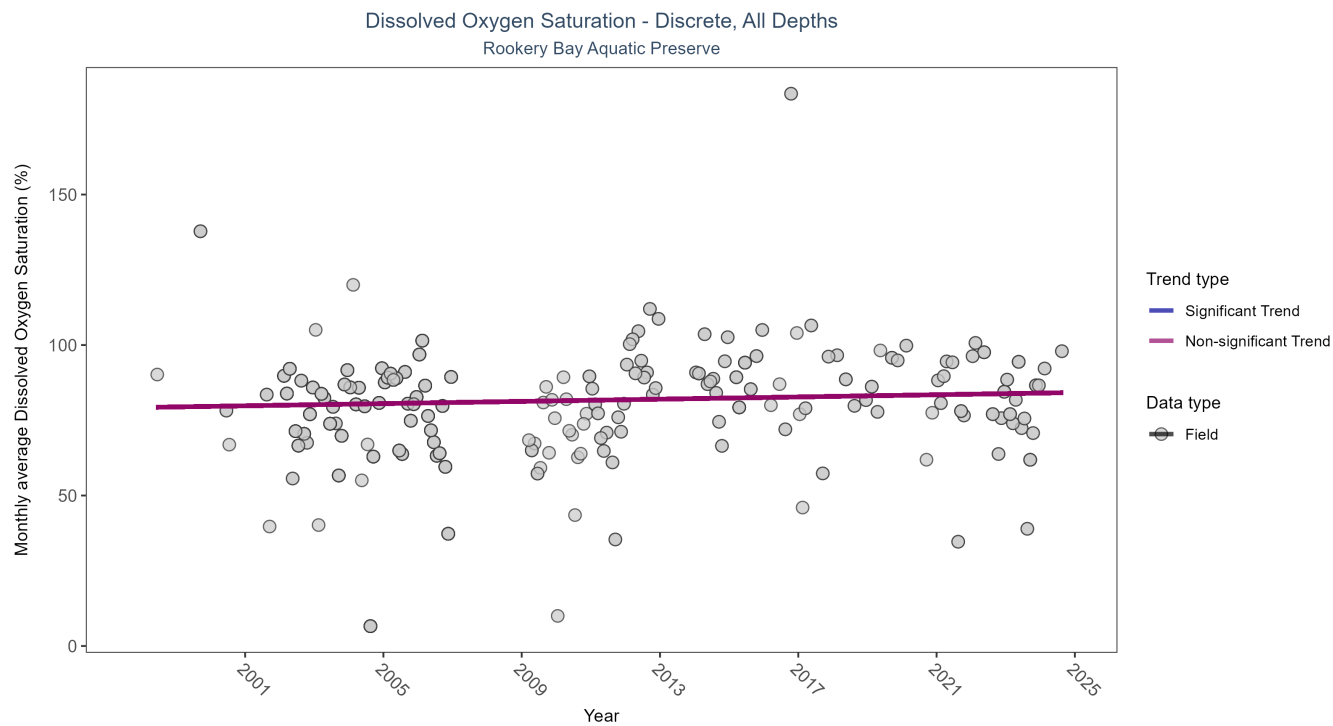


Figure 9: Seasonal Kendall-Tau Results for Dissolved Oxygen Saturation - Discrete

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	791	24	80.9	TRUE	0.0693	0.2483	0.1839	79.2534	7.8556	0.7262	0

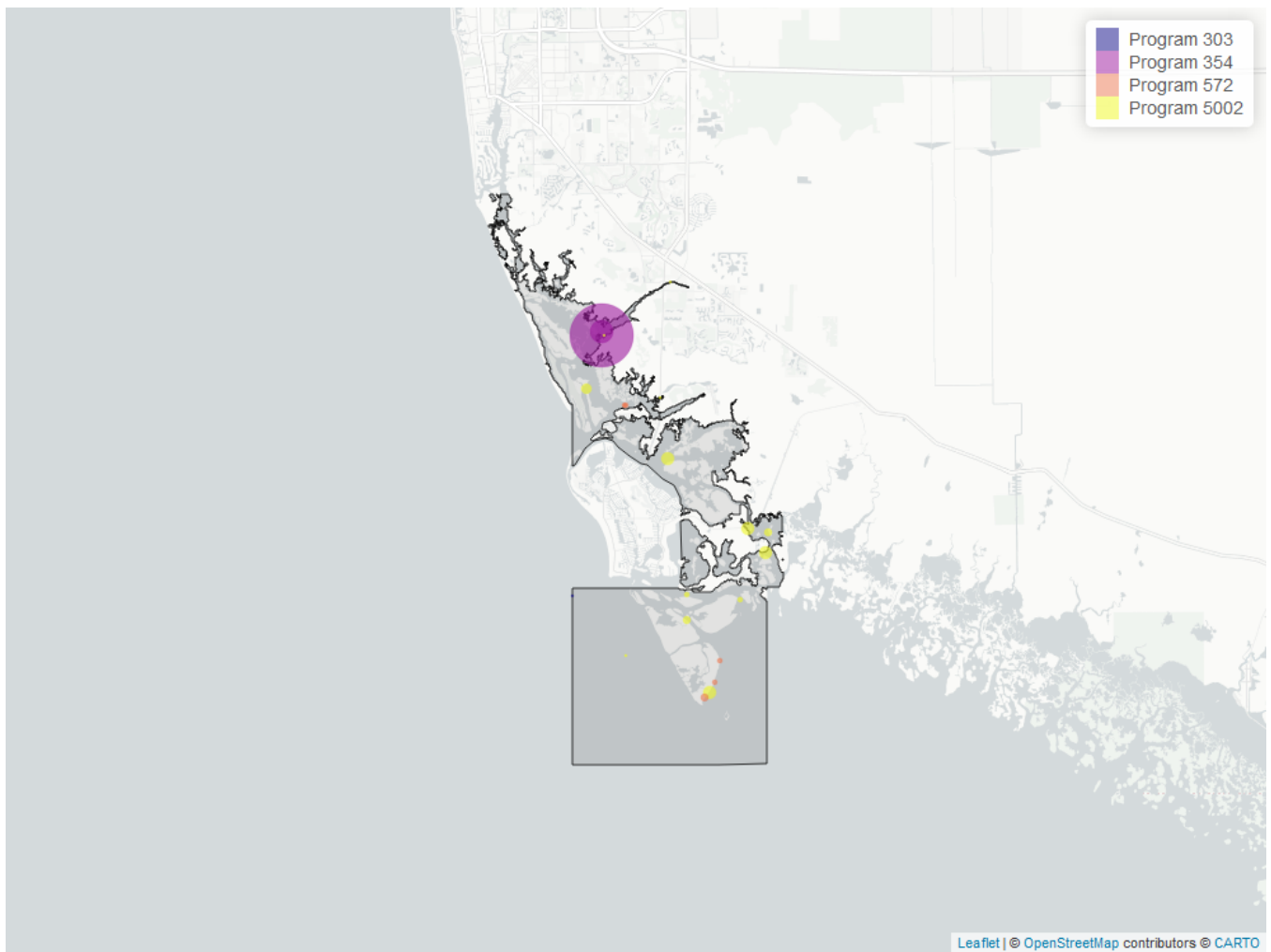


Figure 10: Map showing location of Discrete sampling sites for Dissolved Oxygen Saturation. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 15: Programs contributing data for Dissolved Oxygen Saturation

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
354	703	2002	2024
5002	143	2015	2024
572	27	1998	2005
303	1	2023	2023

**Program names:**

*303* - River, Estuary and Coastal Observing Network<sup>1</sup>

*354* - Rookery Bay National Estuarine Research Reserve System-Wide Monitoring Program<sup>2</sup>

*572* - Rookery Bay National Estuarine Research Reserve Seagrass Monitoring<sup>9</sup>

*5002* - Florida STORET / WIN<sup>3</sup>

**pH - Discrete Water Quality**

**Seasonal Kendall-Tau Trend Analysis**

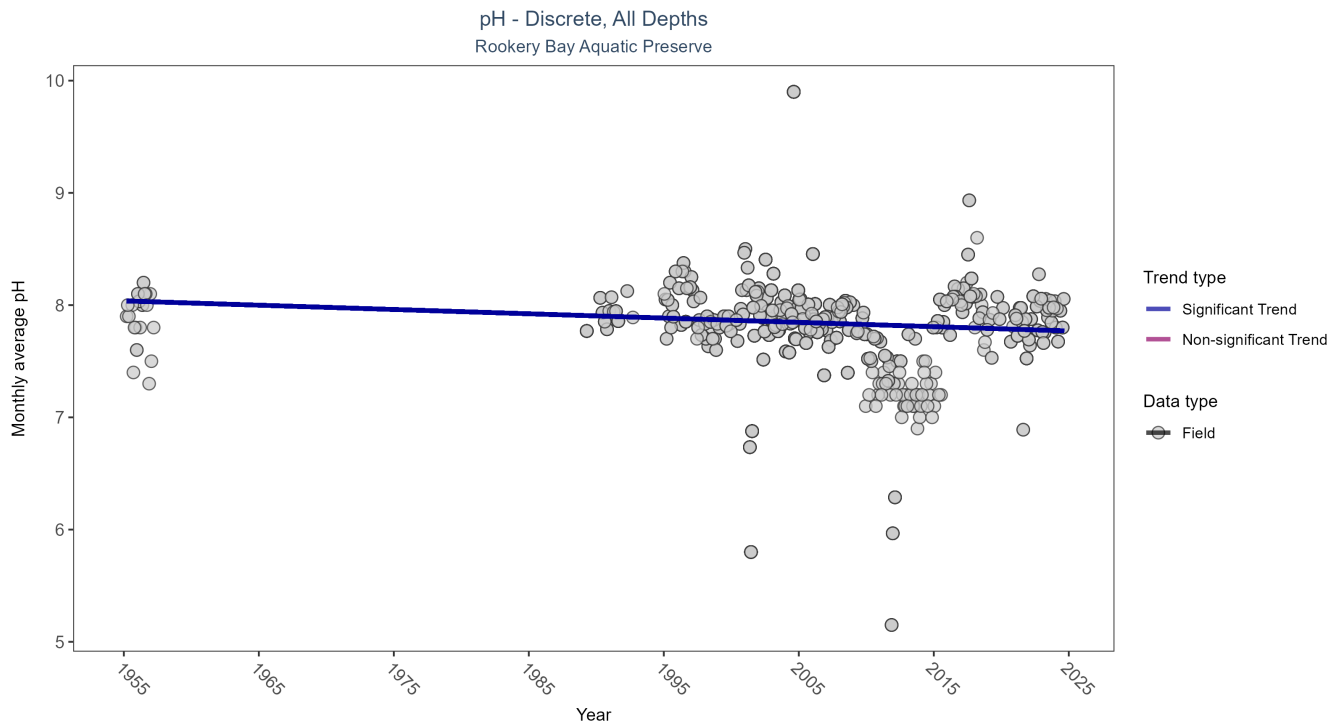


Figure 11: Seasonal Kendall-Tau Results for pH - Discrete

Table 16: Seasonal Kendall-Tau Trend Analysis for pH

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	2450	37	7.9	TRUE	-0.1389	0.0004	-0.0038	8.0376	9.4168	0.5835	-1



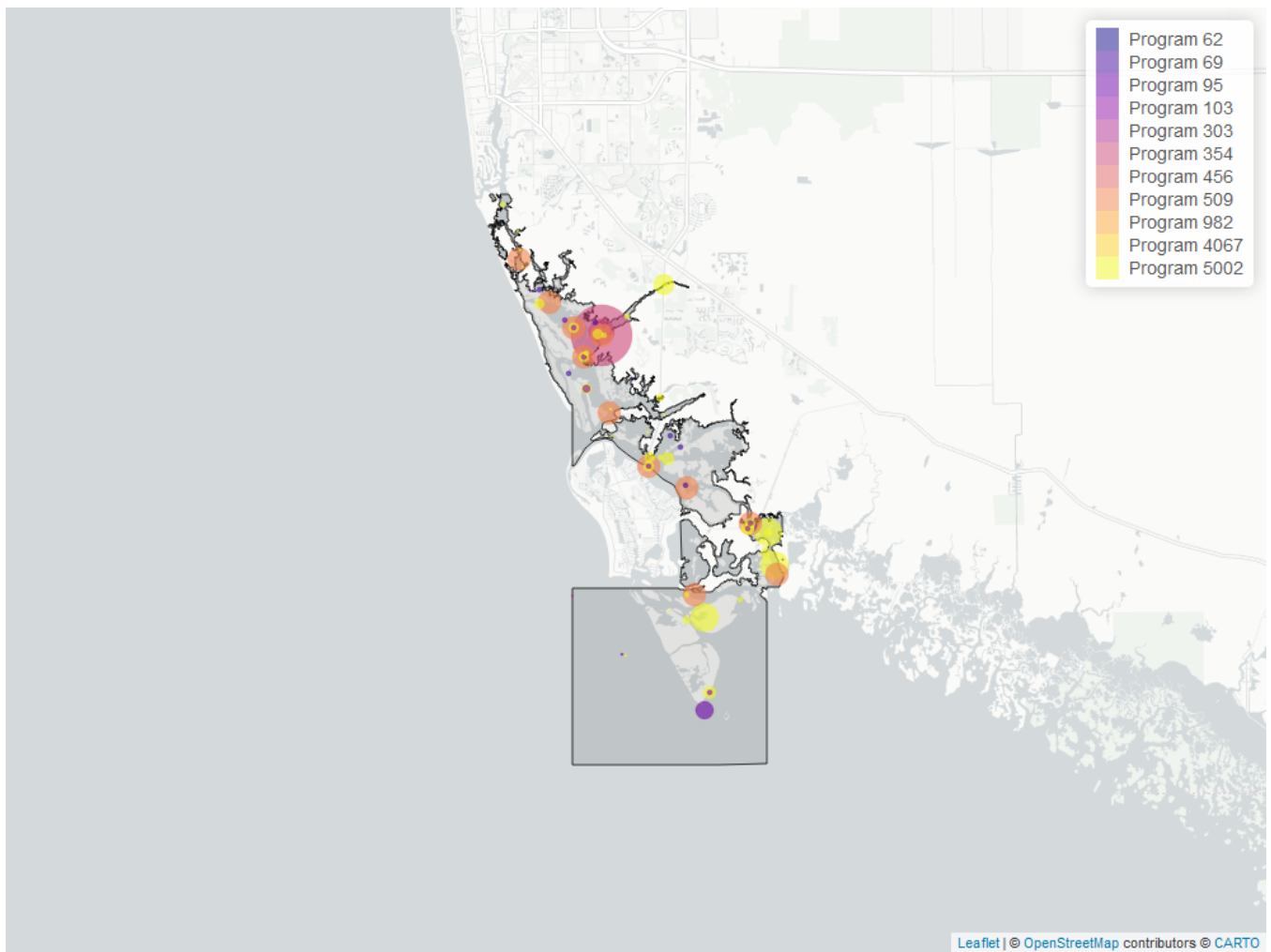


Figure 12: Map showing location of Discrete sampling sites for pH. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 17: Programs contributing data for pH

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
509	971	2001	2008
5002	774	1989	2024
354	664	2002	2024
95	76	1955	2018
103	40	2021	2021
69	22	2001	2001
303	1	2023	2023

**Program names:**

69 - Fisheries-Independent Monitoring (FIM) Program<sup>7</sup>

95 - Harmful Algal Bloom Marine Observation Network<sup>8</sup>

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX<sup>4</sup>

303 - River, Estuary and Coastal Observing Network<sup>1</sup>

354 - Rookery Bay National Estuarine Research Reserve System-Wide Monitoring Program<sup>2</sup>

## Salinity - Discrete Water Quality

### Seasonal Kendall-Tau Trend Analysis

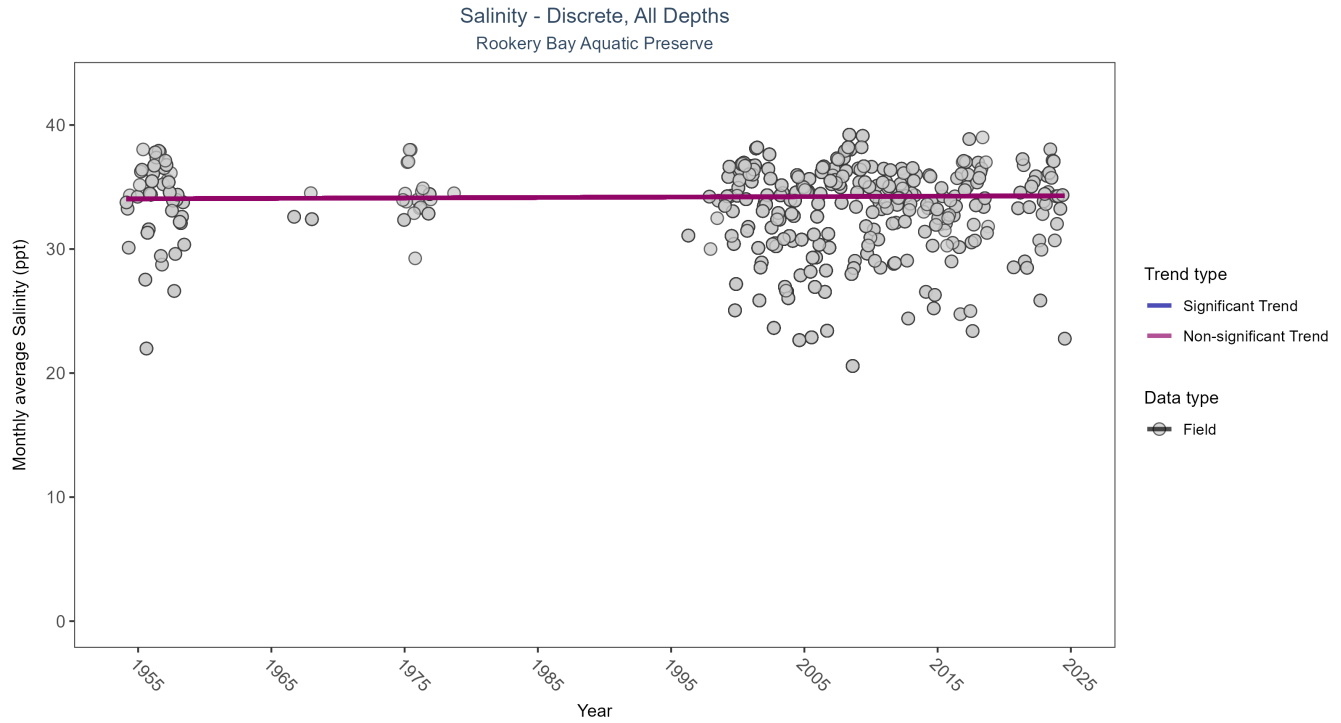


Figure 13: Seasonal Kendall-Tau Results for Salinity - Discrete

Table 18: Seasonal Kendall-Tau Trend Analysis for Salinity

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	5272	45	34.1	TRUE	0.0144	0.6726	0.0035	34.0471	4.4839	0.9536	0

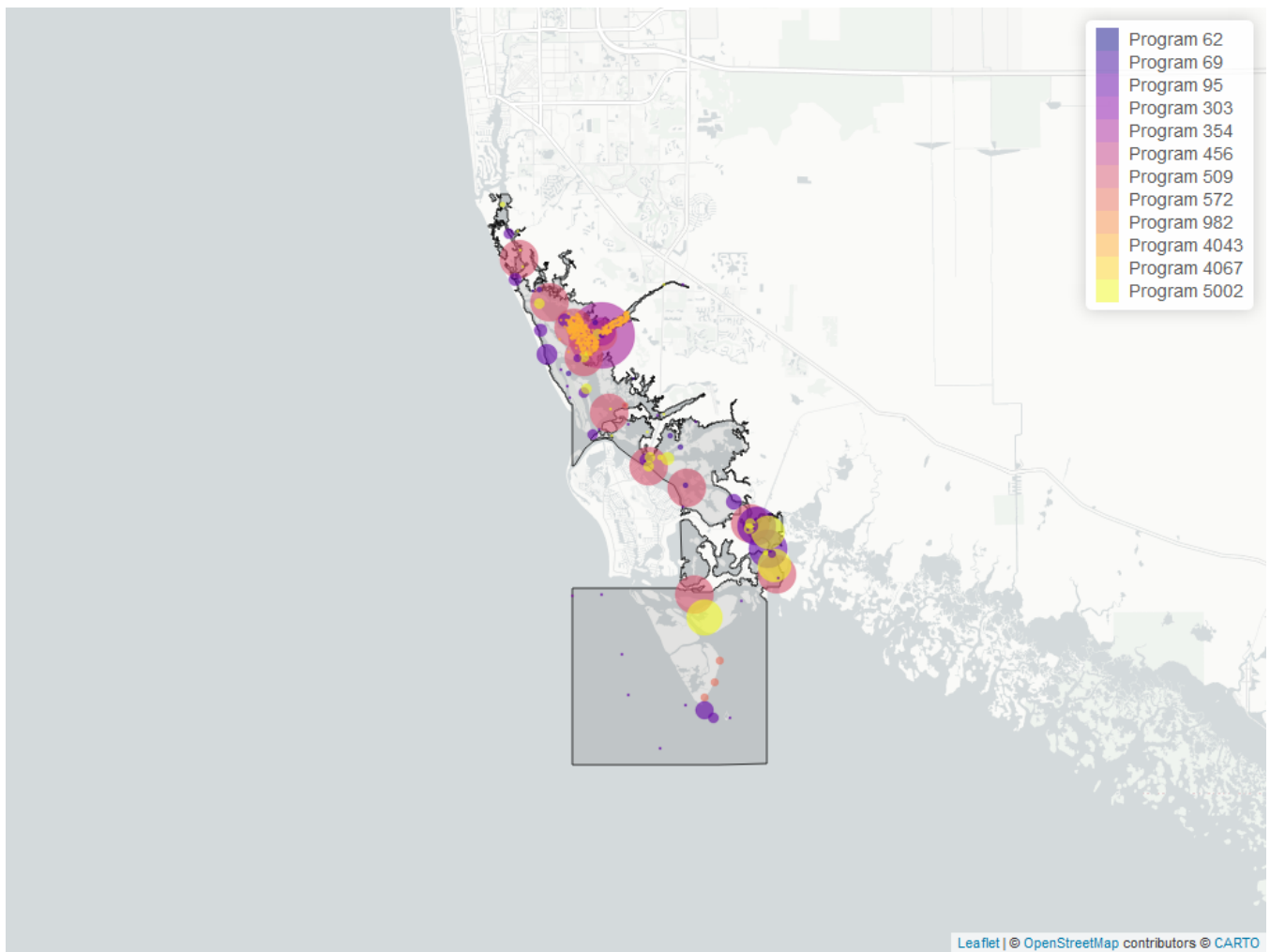


Figure 14: Map showing location of Discrete sampling sites for Salinity. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 19: Programs contributing data for Salinity

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
509	2439	1999	2008
95	843	1954	2018
354	814	2002	2023
5002	748	1989	2024
4043	499	2000	2009
572	31	1998	2005
69	22	2001	2001
303	1	2023	2023

**Program names:**

69 - Fisheries-Independent Monitoring (FIM) Program<sup>7</sup>

95 - Harmful Algal Bloom Marine Observation Network<sup>8</sup>

303 - River, Estuary and Coastal Observing Network<sup>1</sup>

354 - Rookery Bay National Estuarine Research Reserve System-Wide Monitoring Program<sup>2</sup>

509 - SERC Water Quality Monitoring Network<sup>5</sup>

## Secchi Depth - Discrete Water Quality

### Seasonal Kendall-Tau Trend Analysis

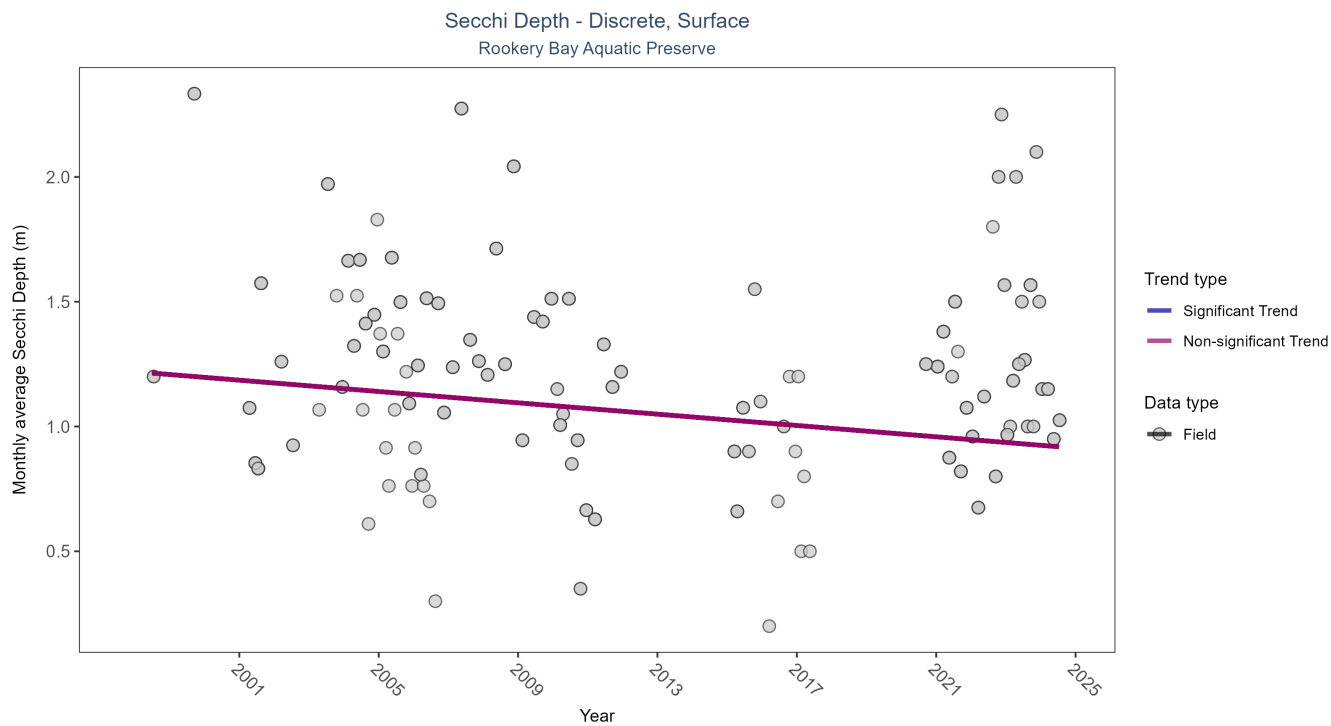


Figure 15: Seasonal Kendall-Tau Results for Secchi Depth - Discrete

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	436	21	1.2	TRUE	-0.1218	0.1146	-0.0113	1.2195	12.8513	0.3032	0

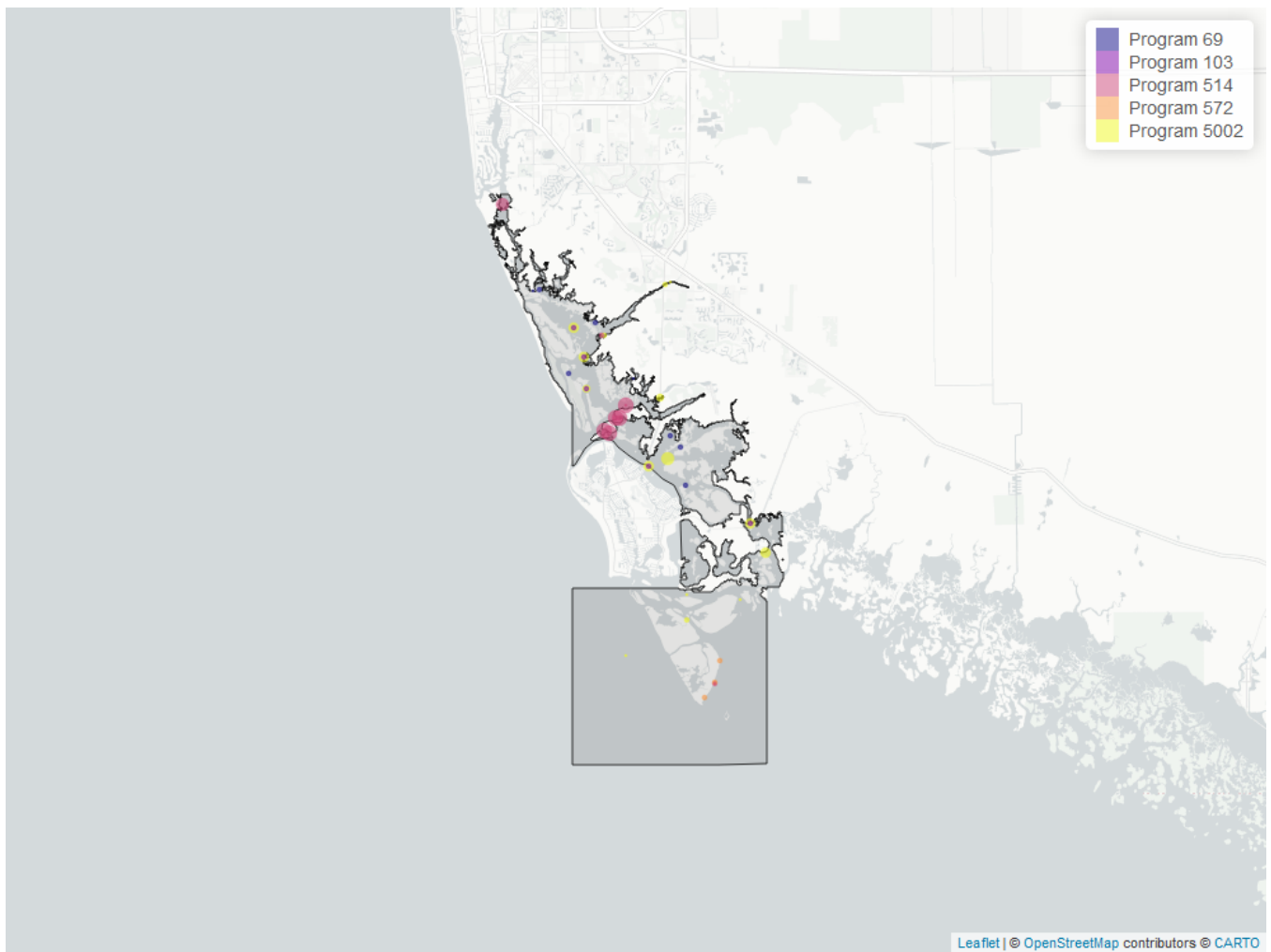


Figure 16: Map showing location of Discrete sampling sites for Secchi Depth. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 21: Programs contributing data for Secchi Depth

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
514	216	2001	2011
5002	161	2006	2024
103	28	2021	2021
69	22	2001	2001
572	9	1998	2003

**Program names:**

- 69 - Fisheries-Independent Monitoring (FIM) Program<sup>7</sup>
- 103 - EPA STORage and RETrieval Data Warehouse (STORET)/WQX<sup>4</sup>
- 514 - Florida LAKEWATCH Program<sup>6</sup>
- 572 - Rookery Bay National Estuarine Research Reserve Seagrass Monitoring<sup>9</sup>
- 5002 - Florida STORET / WIN<sup>3</sup>

**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)  $TN = TKN + NO_3O_2$ ;
- 2)  $TN = TKN + NO_3 + NO_2$ ;
- 3)  $TN = ORGN + NH_4 + NO_3O_2$ ;
- 4)  $TN = ORGN + NH_4 + NO_2 + NO_3$ ;
- 5)  $TN = TKN + NO_3$ ;
- 6)  $TN = ORGN + NH_4 + NO_3$ ;

Additional Information:

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

## Seasonal Kendall-Tau Trend Analysis

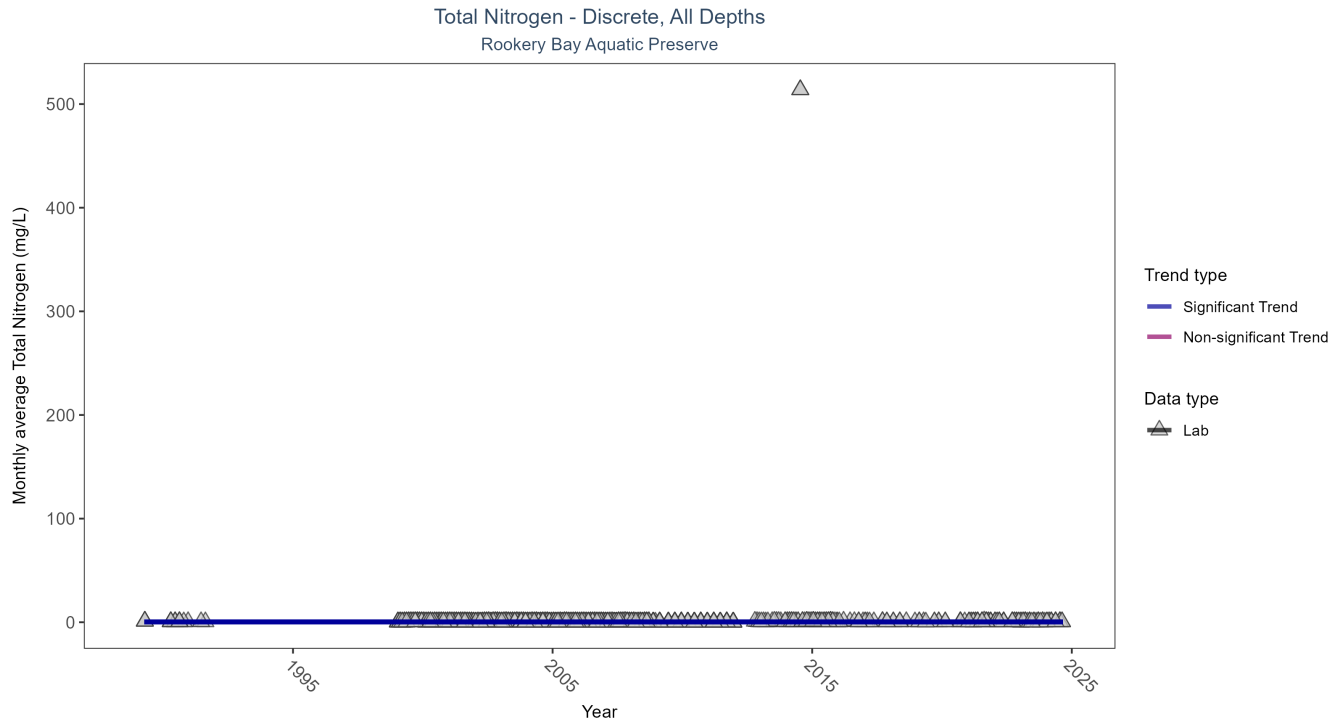


Figure 17: Seasonal Kendall-Tau Results for Total Nitrogen - Discrete

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	2763	29	0.26	TRUE	0.1757	0.0002	0.0058	0.2146	6.5477	0.8344	1

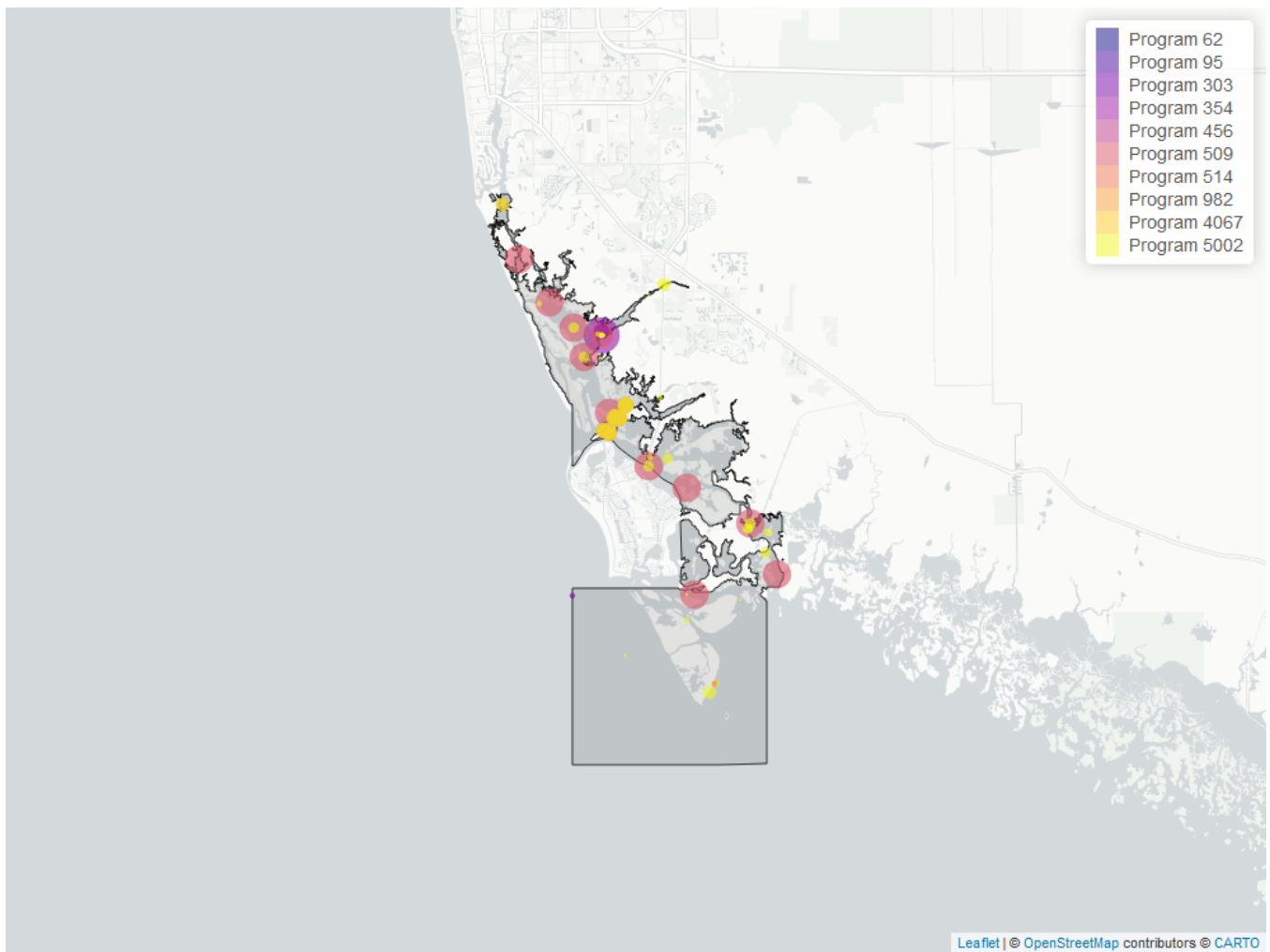


Figure 18: Map showing location of Discrete sampling sites for Total Nitrogen. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 23: Programs contributing data for Total Nitrogen

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
509	1246	1999	2008
5002	769	1989	2024
514	546	2001	2011
354	239	2002	2018
303	3	2022	2023

**Program names:**

303 - River, Estuary and Coastal Observing Network<sup>1</sup>

354 - Rookery Bay National Estuarine Research Reserve System-Wide Monitoring Program<sup>2</sup>

509 - SERC Water Quality Monitoring Network<sup>5</sup>

514 - Florida LAKEWATCH Program<sup>6</sup>

5002 - Florida STORET / WIN<sup>3</sup>

**Total Phosphorus - Discrete Water Quality**

**Seasonal Kendall-Tau Trend Analysis**



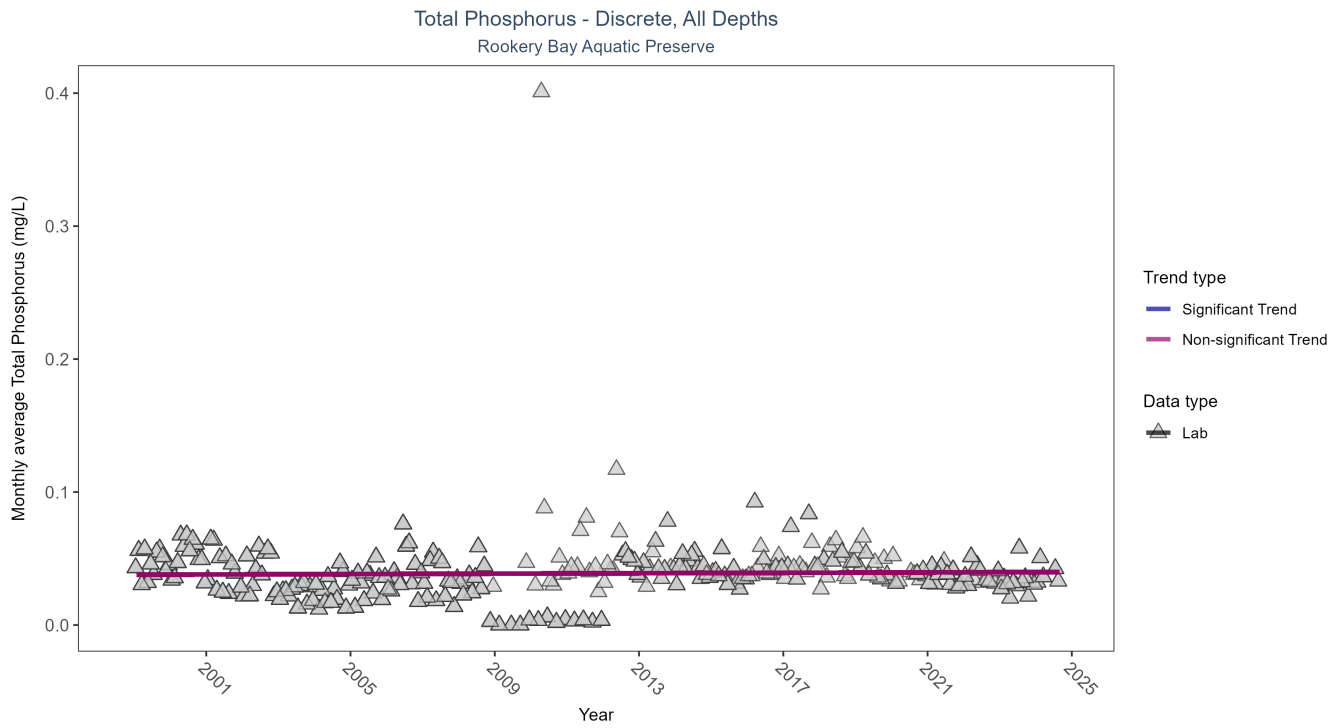


Figure 19: Seasonal Kendall-Tau Results for Total Phosphorus - Discrete

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	2383	26	0.034	TRUE	0.0277	0.4884	0.0001	0.0379	9.2055	0.6029	0

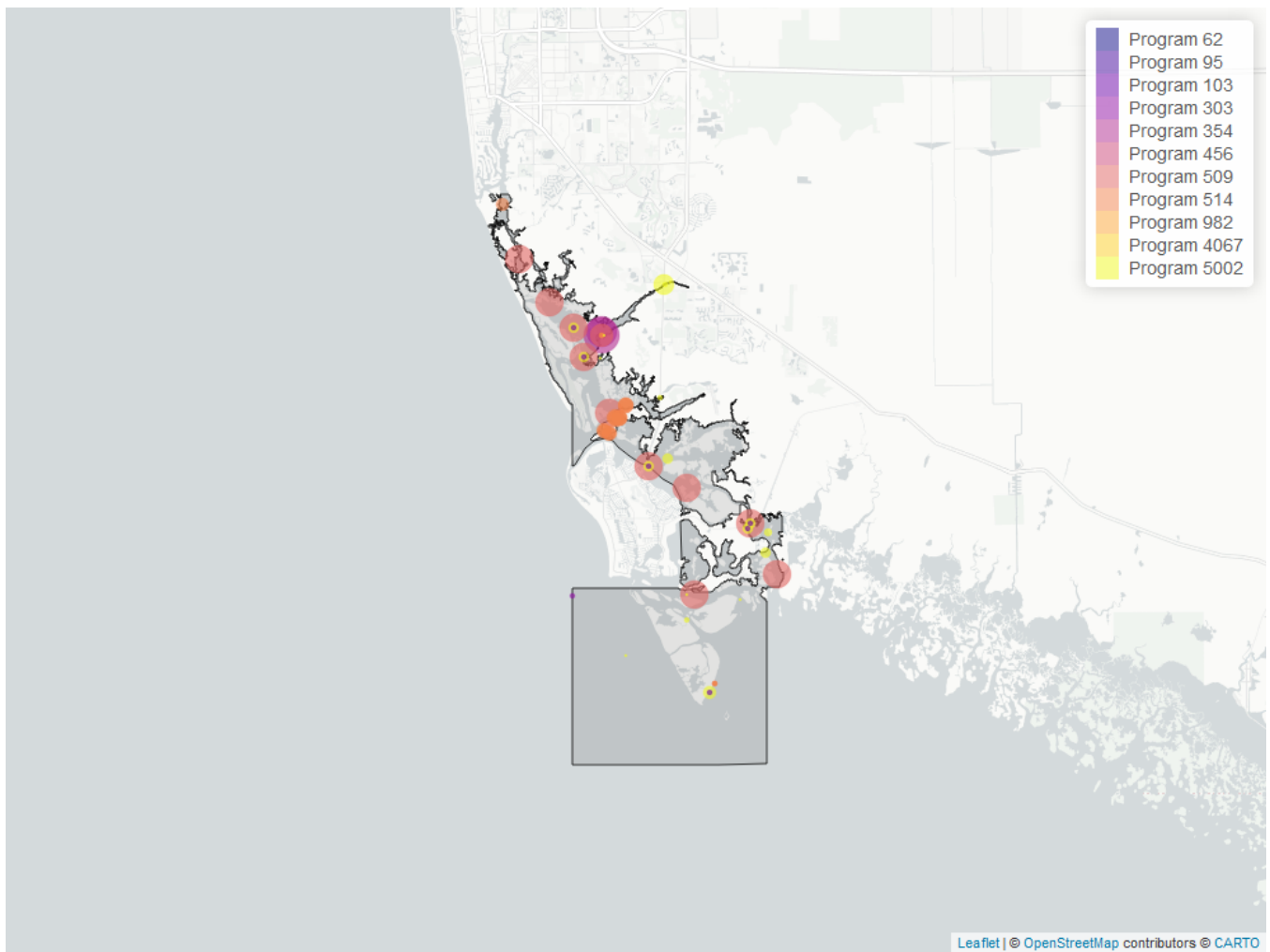


Figure 20: Map showing location of Discrete sampling sites for Total Phosphorus. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 25: Programs contributing data for Total Phosphorus

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
509	1236	1999	2008
514	542	2001	2011
354	335	2002	2024
5002	252	2002	2024
103	32	2021	2021
303	3	2022	2023

**Program names:**

103 - EPA STORage and RETrieval Data Warehouse (STORET)/WQX<sup>4</sup>

303 - River, Estuary and Coastal Observing Network<sup>1</sup>

354 - Rookery Bay National Estuarine Research Reserve System-Wide Monitoring Program<sup>2</sup>

509 - SERC Water Quality Monitoring Network<sup>5</sup>

514 - Florida LAKEWATCH Program<sup>6</sup>

5002 - Florida STORET / WIN<sup>3</sup>

# Total Suspended Solids - Discrete Water Quality

## Seasonal Kendall-Tau Trend Analysis

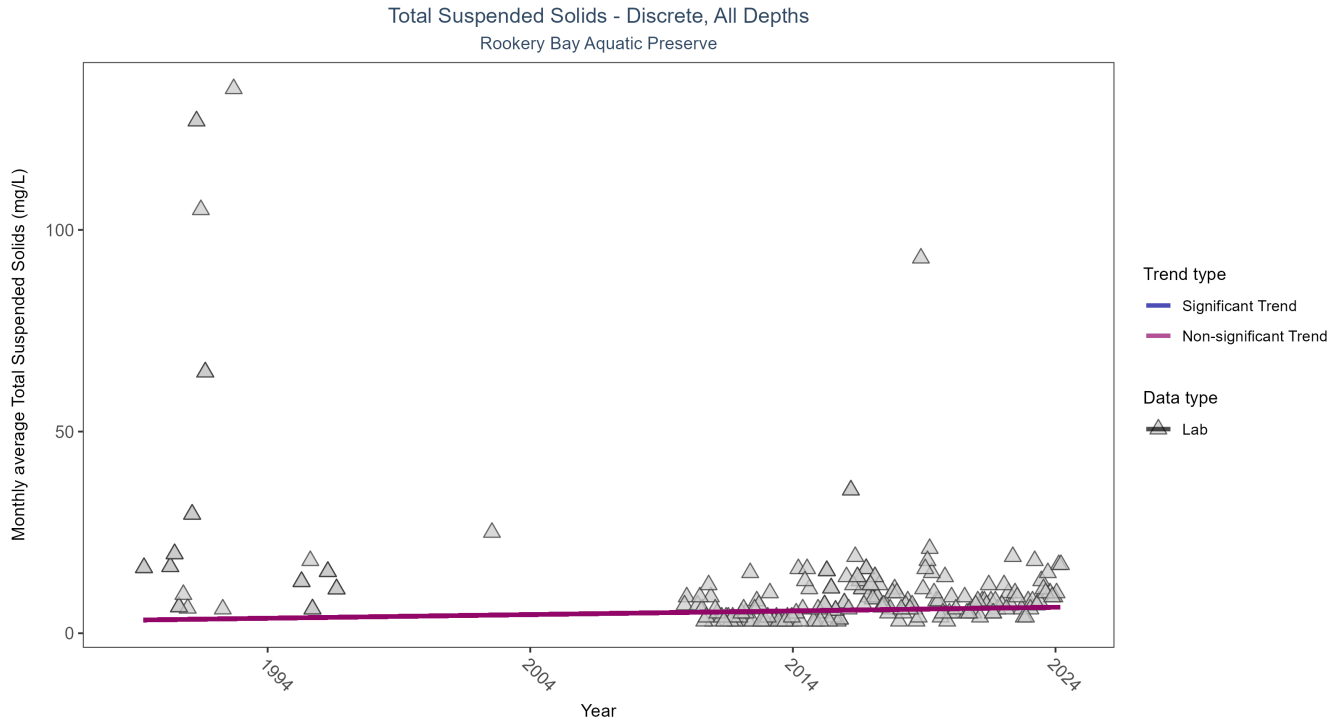


Figure 21: Seasonal Kendall-Tau Results for Total Suspended Solids - Discrete

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	245	23	8	TRUE	0.1144	0.0803	0.0909	3.2664	12.3975	0.3345	0

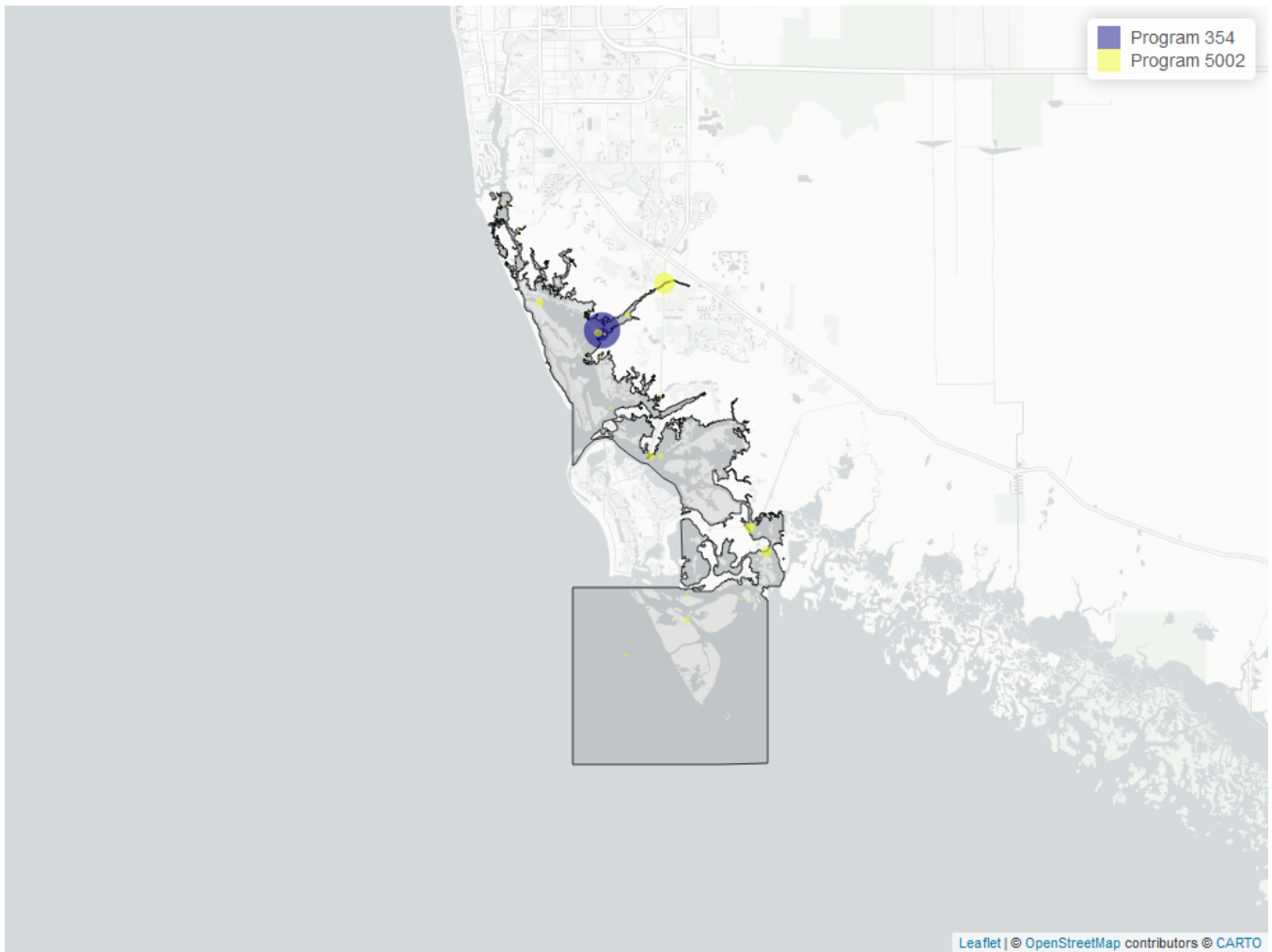


Figure 22: Map showing location of Discrete sampling sites for Total Suspended Solids. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 27: Programs contributing data for Total Suspended Solids

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
354	216	2016	2024
5002	151	1989	2021

**Program names:**

*354* - Rookery Bay National Estuarine Research Reserve System-Wide Monitoring Program<sup>2</sup>

*5002* - Florida STORET / WIN<sup>3</sup>

**Turbidity - Discrete Water Quality**

**Seasonal Kendall-Tau Trend Analysis**

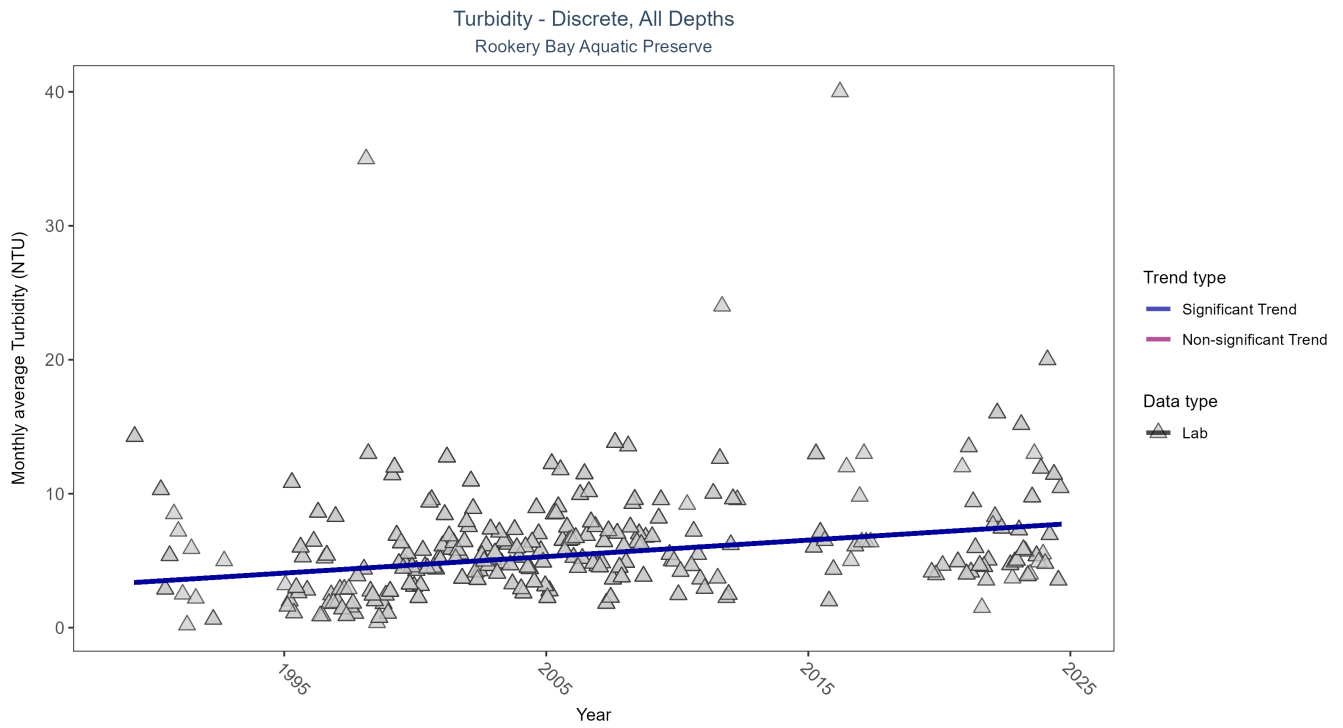


Figure 23: Seasonal Kendall-Tau Results for Turbidity - Discrete

Table 28: Seasonal Kendall-Tau Trend Analysis for Turbidity

RelativeDepth	N-Data	N-Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	1843	31	4.995	TRUE	0.2463	0	0.1231	3.3359	13.375	0.2695	1

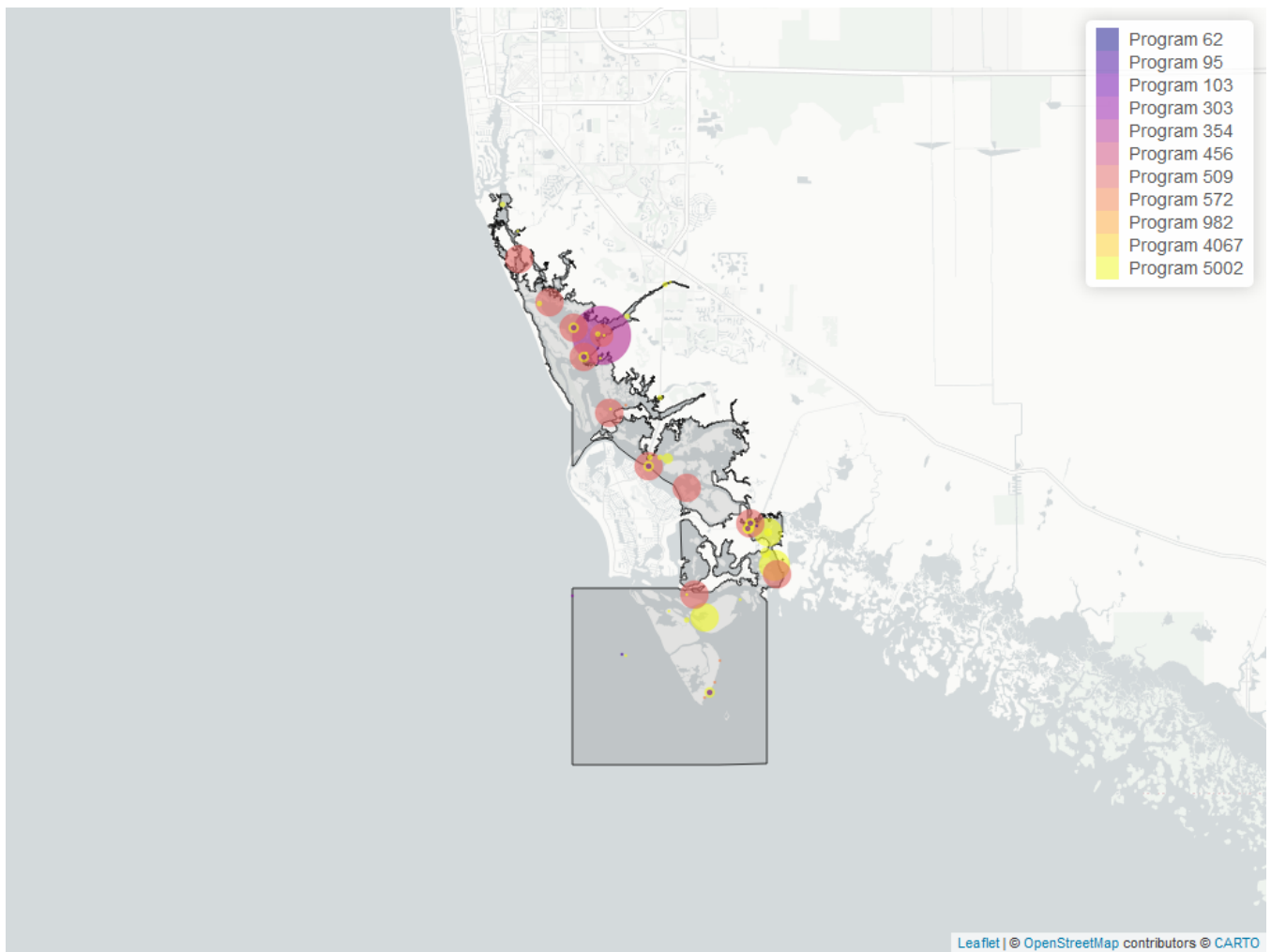


Figure 24: Map showing location of Discrete sampling sites for Turbidity. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 29: Programs contributing data for Turbidity

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
509	1236	1999	2008
5002	614	1989	2024
354	527	2002	2006
103	32	2021	2021
572	4	2000	2003
95	3	2003	2011
303	1	2023	2023

**Program names:**

95 - Harmful Algal Bloom Marine Observation Network<sup>8</sup>

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX<sup>4</sup>

303 - River, Estuary and Coastal Observing Network<sup>1</sup>

354 - Rookery Bay National Estuarine Research Reserve System-Wide Monitoring Program<sup>2</sup>

509 - SERC Water Quality Monitoring Network<sup>5</sup>

## Water Temperature - Discrete Water Quality

### Seasonal Kendall-Tau Trend Analysis

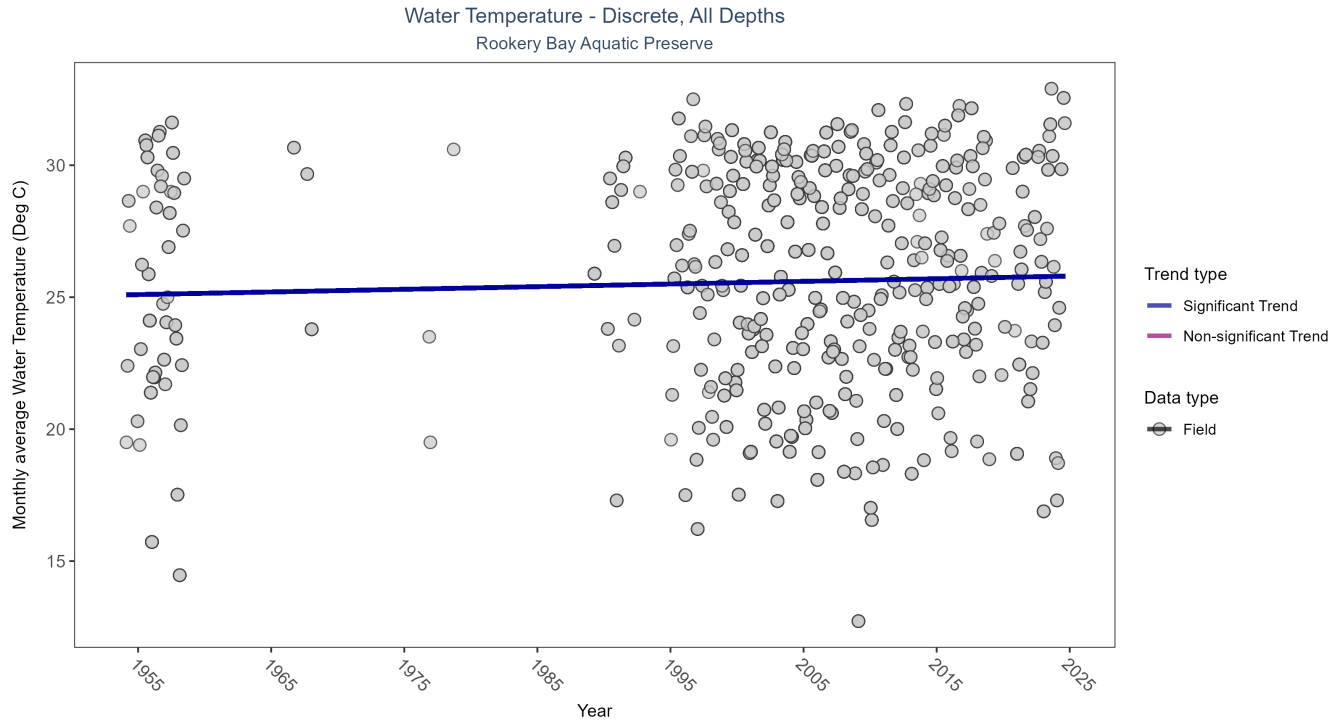


Figure 25: Seasonal Kendall-Tau Results for Water Temperature - Discrete

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	5225	44	26.4	TRUE	0.0768	0.0273	0.01	25.0885	7.9601	0.7169	1

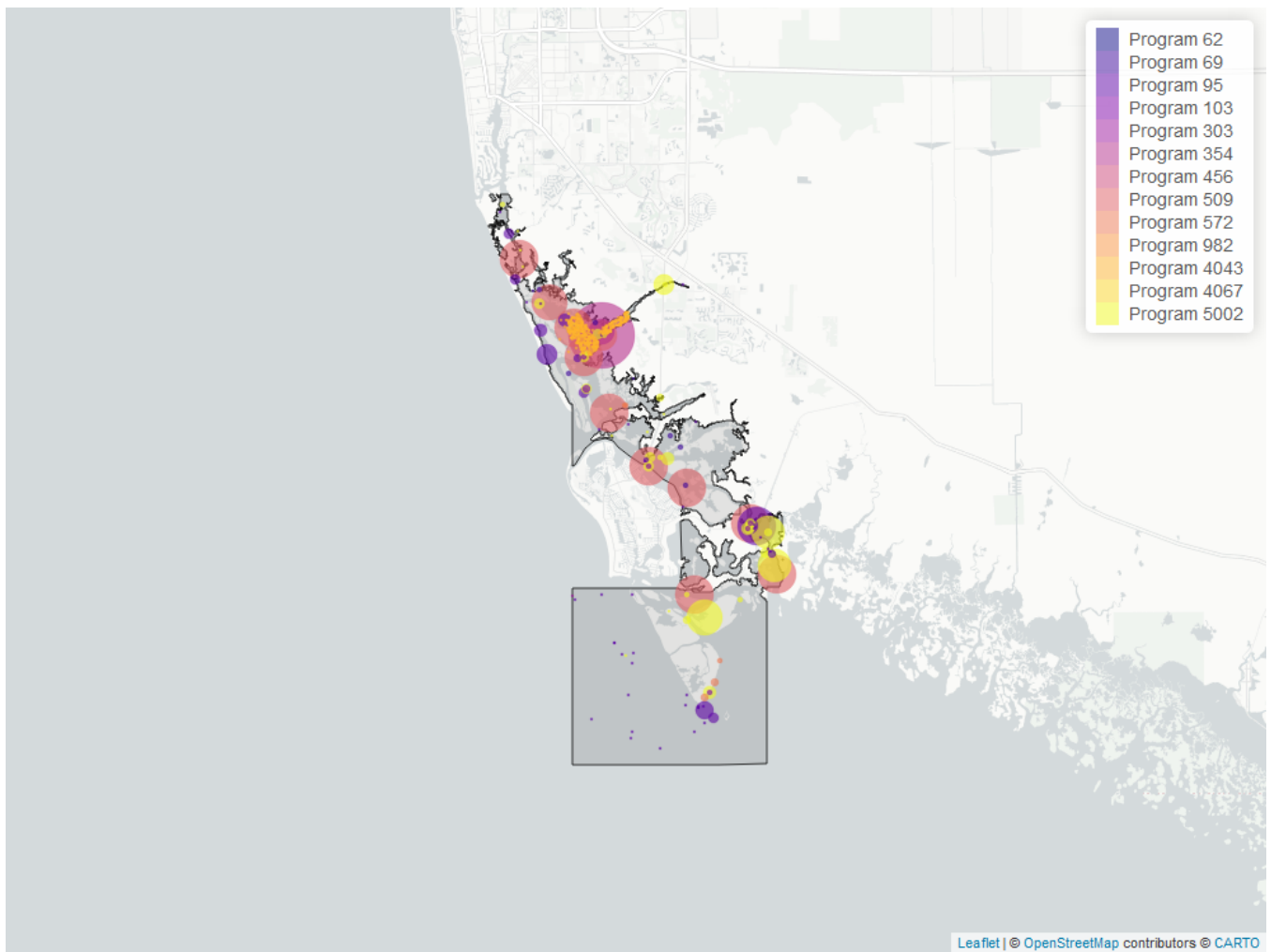


Figure 26: Map showing location of Discrete sampling sites for Water Temperature. The bubble size on the maps below reflect the amount of data available at each sampling site.

Table 31: Programs contributing data for Water Temperature

<i>ProgramID</i>	<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>
509	2443	1999	2008
5002	941	1989	2024
354	785	2002	2024
95	561	1954	2018
4043	498	2000	2009
103	40	2021	2021
572	30	1998	2005
69	22	2001	2001
303	1	2023	2023

**Program names:**

69 - Fisheries-Independent Monitoring (FIM) Program<sup>7</sup>

95 - Harmful Algal Bloom Marine Observation Network<sup>8</sup>

103 - EPA STOrage and RETrieval Data Warehouse (STORET)/WQX<sup>4</sup>

303 - River, Estuary and Coastal Observing Network<sup>1</sup>



354 - Rookery Bay National Estuarine Research Reserve System-Wide Monitoring Program<sup>2</sup>  
509 - SERC Water Quality Monitoring Network<sup>5</sup>  
572 - Rookery Bay National Estuarine Research Reserve Seagrass Monitoring<sup>9</sup>  
4043 - RBNERR Fish Assessment<sup>10</sup>  
5002 - Florida STORET / WIN<sup>3</sup>

## 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 Aquatic Preserve

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

<i>ProgramLocationID</i>	<i>Years of Data</i>	<i>Use in Analysis</i>	<i>Parameters</i>
rkbmwq	2	FALSE	DO , DOS , pH , Sal , Turb , TempW
rkbhwq	24	TRUE	DO , DOS , pH , Sal , Turb , TempW

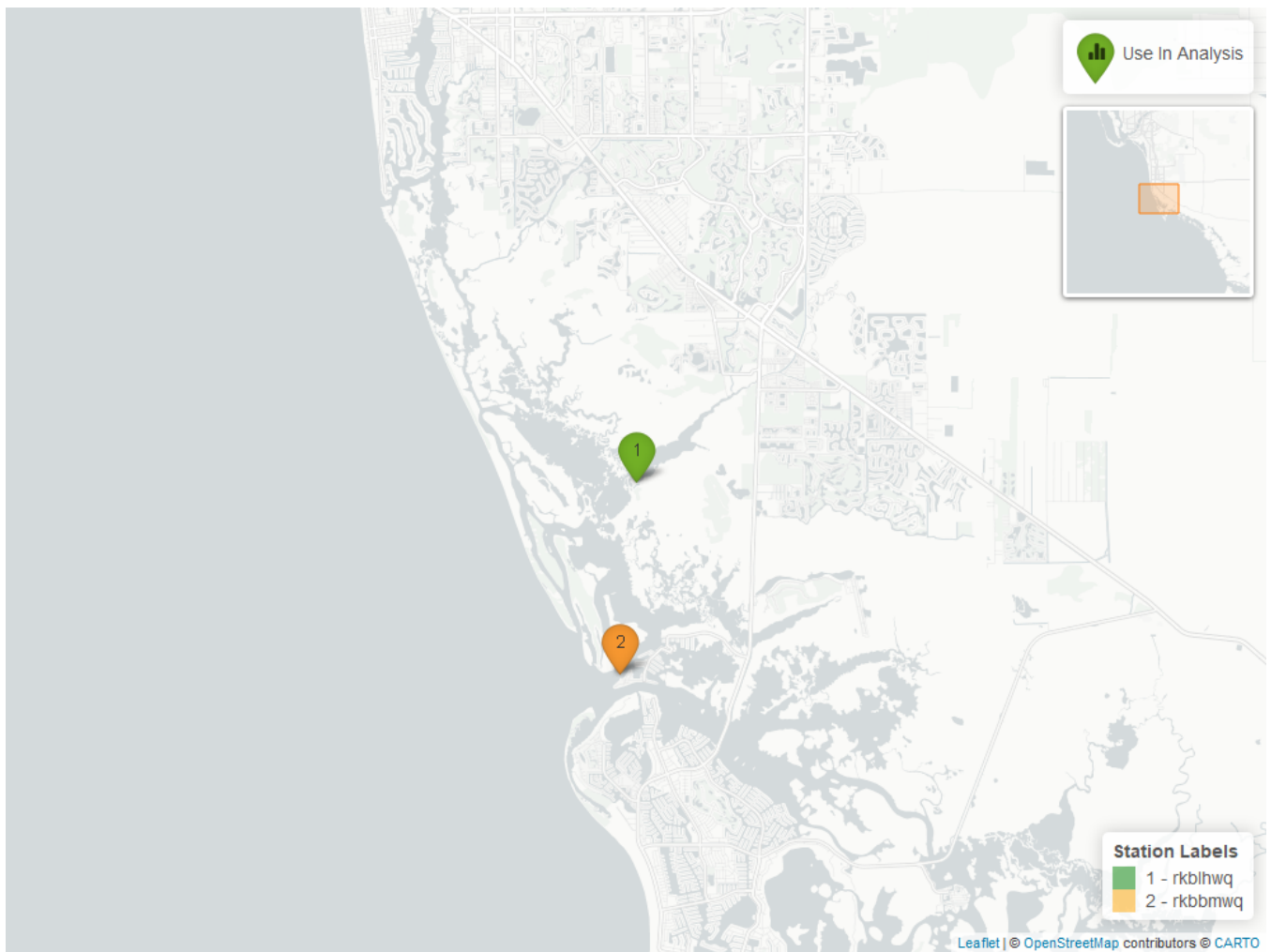


Figure 27: Map showing Continuous Water Quality Monitoring sampling locations within the boundaries of Rookery Bay Aquatic Preserve. Sites marked as *Use In Analysis* are featured in this report.

## Dissolved Oxygen - All Stations Combined

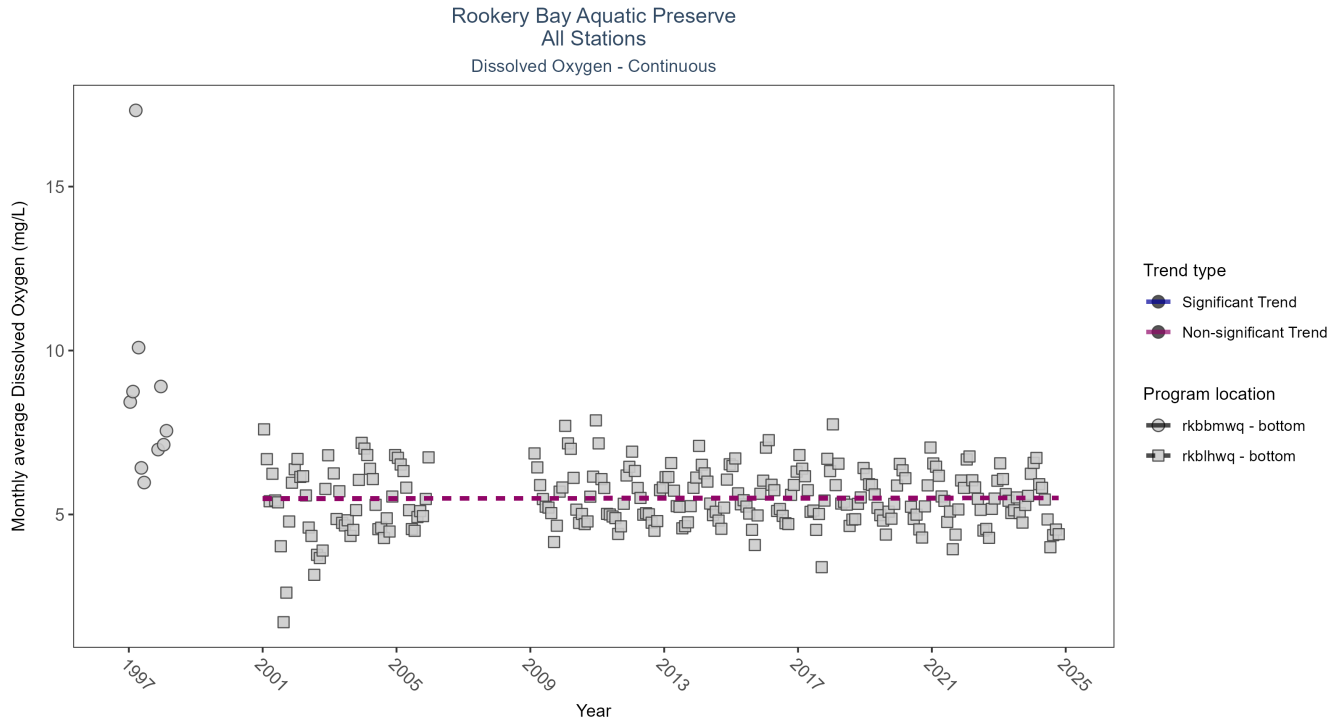


Figure 28: Figure for Dissolved Oxygen - Continuous - All stations combined

Table 33: 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	-	-	-	-
rkblhwq	570691	21	2001 - 2024	5.5	0	5.48	0	0.8577

# Dissolved Oxygen Saturation - All Stations Combined

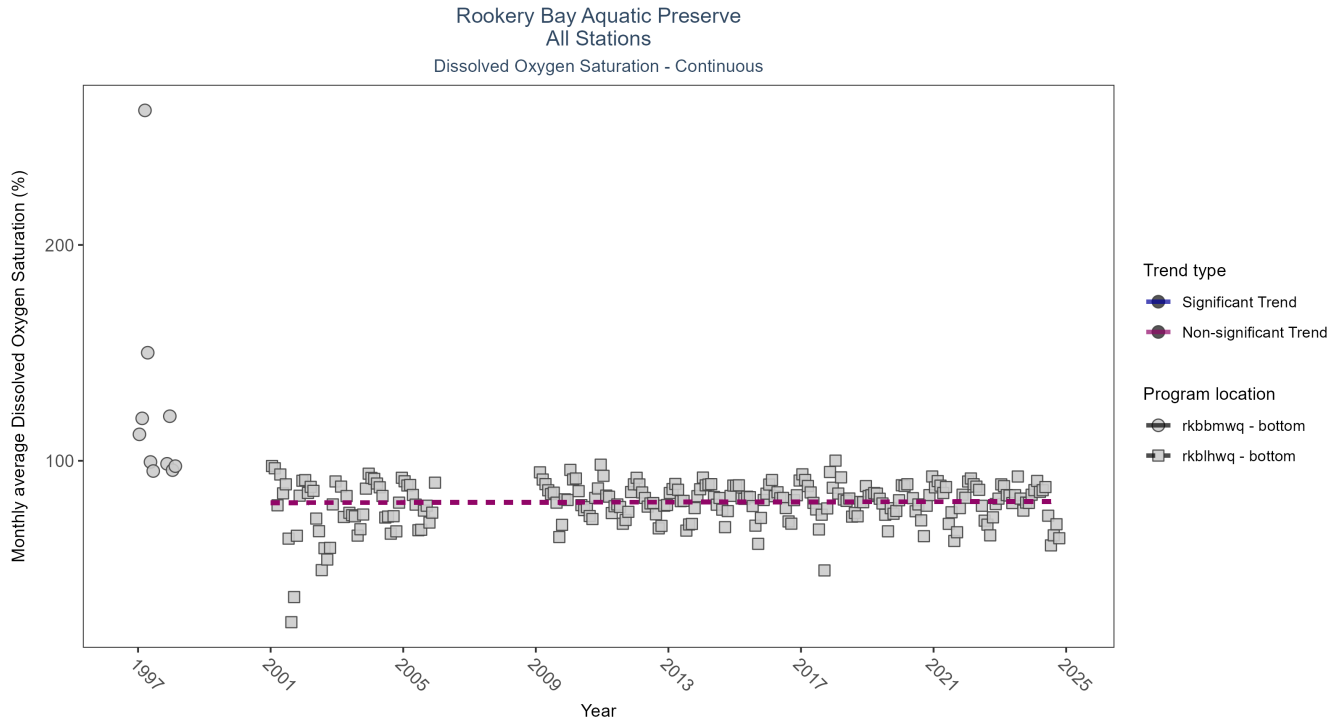


Figure 29: Figure for Dissolved Oxygen Saturation - Continuous - All stations combined

Table 34: 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	-	-	-	-
rkblhwq	583009	21	2001 - 2024	81.7	0.02	80.58	0.02	0.5540

# pH - All Stations Combined

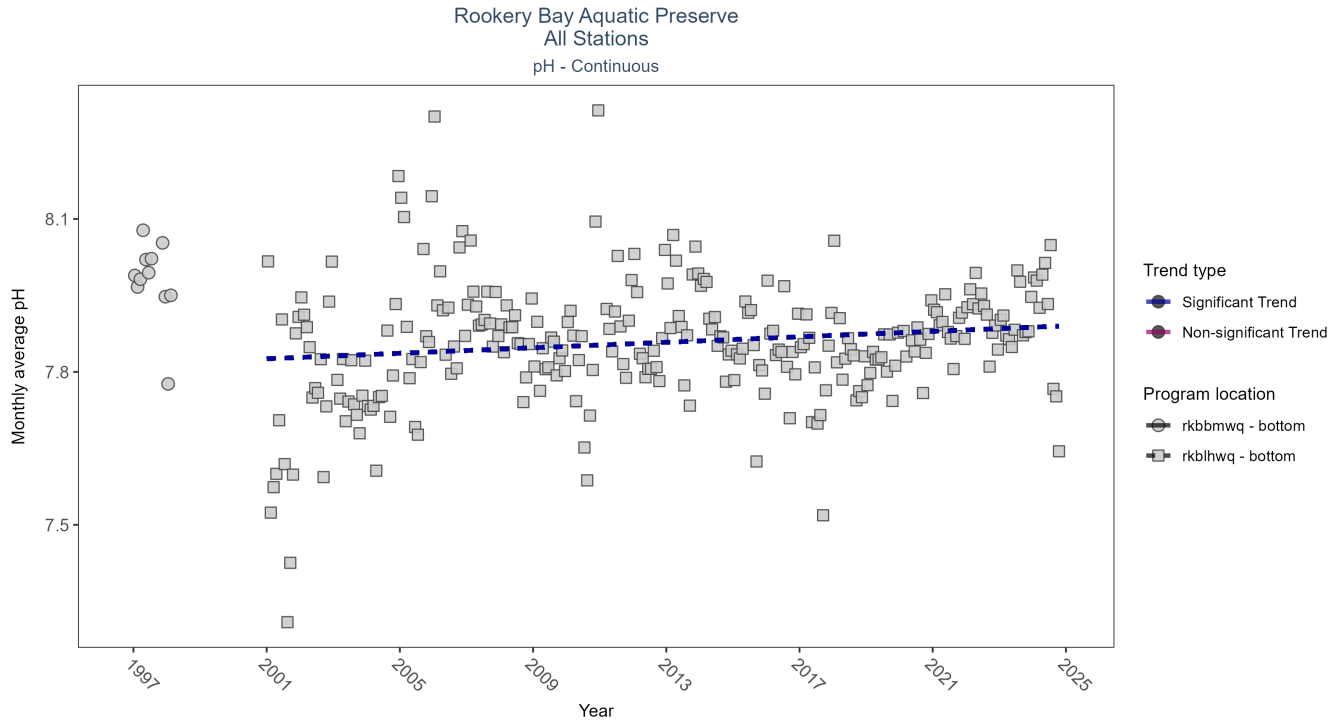


Figure 30: Figure for pH - Continuous - All stations combined

Table 35: Seasonal Kendall-Tau Results for All Stations - pH

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
rkbbmwq	12610	2	1997 - 1998	8.0	-	-	-	-
rkblhwq	629829	24	2001 - 2024	7.9	0.14	7.83	0	0.0010

# Salinity - All Stations Combined

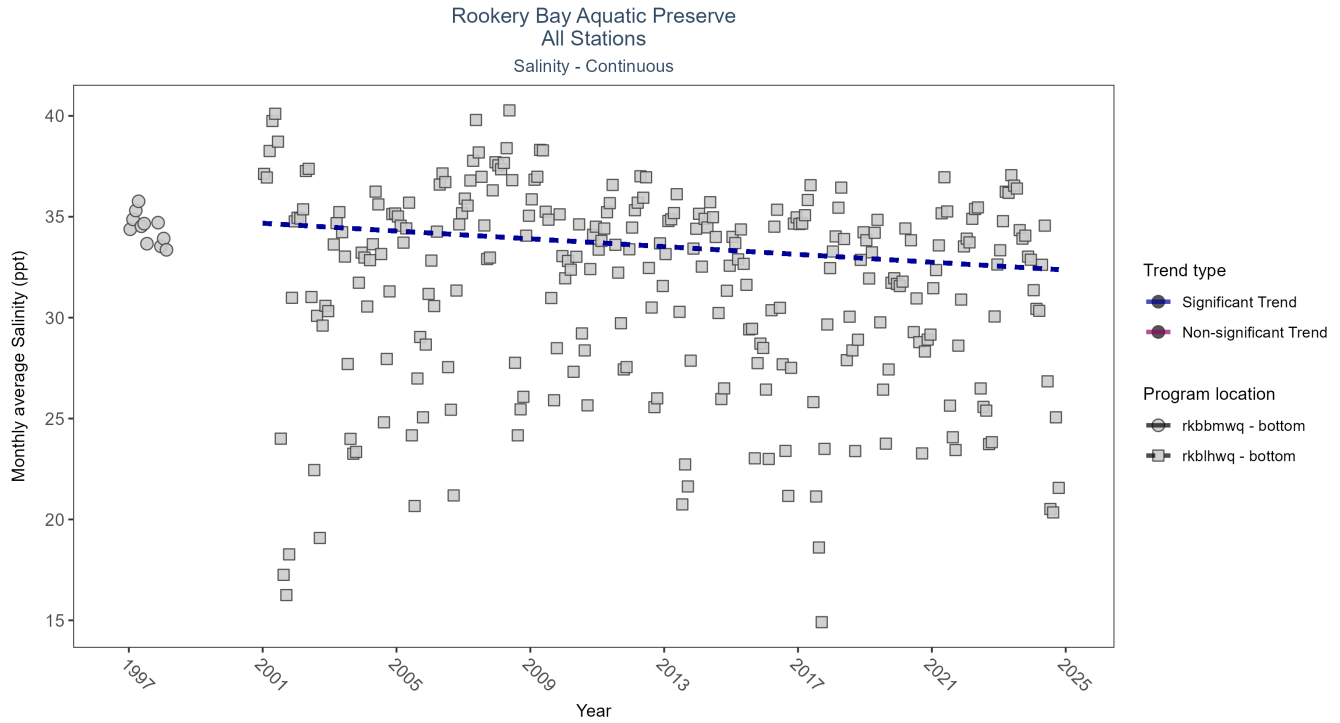


Figure 31: Figure for Salinity - Continuous - All stations combined

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

Station	N_Data	N_Years	Period of Record	Median	tau	SennIntercept	SennSlope	p
rkbbmwq	12256	2	1997 - 1998	34.5	-	-	-	-
rkblhwq	657842	24	2001 - 2024	33.1	-0.16	34.68	-0.1	0.0001

## Turbidity - All Stations Combined

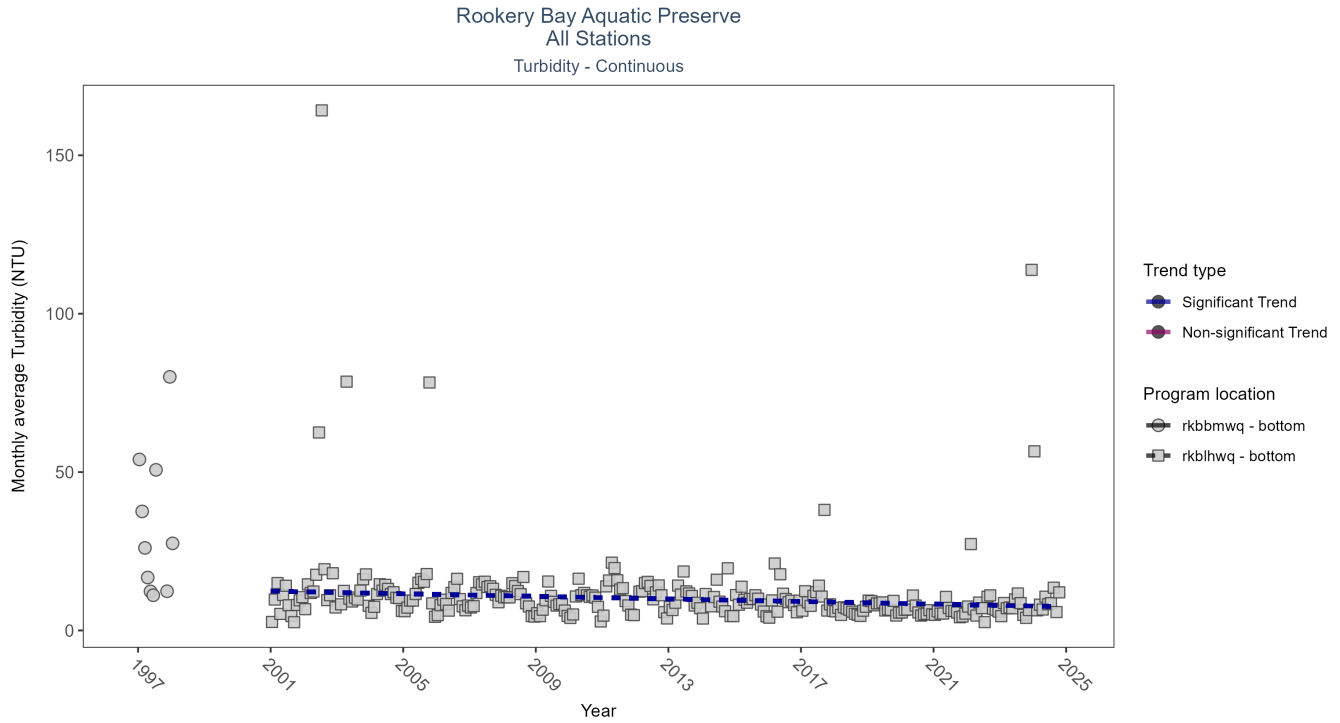


Figure 32: Figure for Turbidity - Continuous - All stations combined

Table 37: 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	-	-	-	-
rkblhwq	605017	24	2001 - 2024	8	-0.27	12.4	-0.2	0.0000



# Water Temperature - All Stations Combined

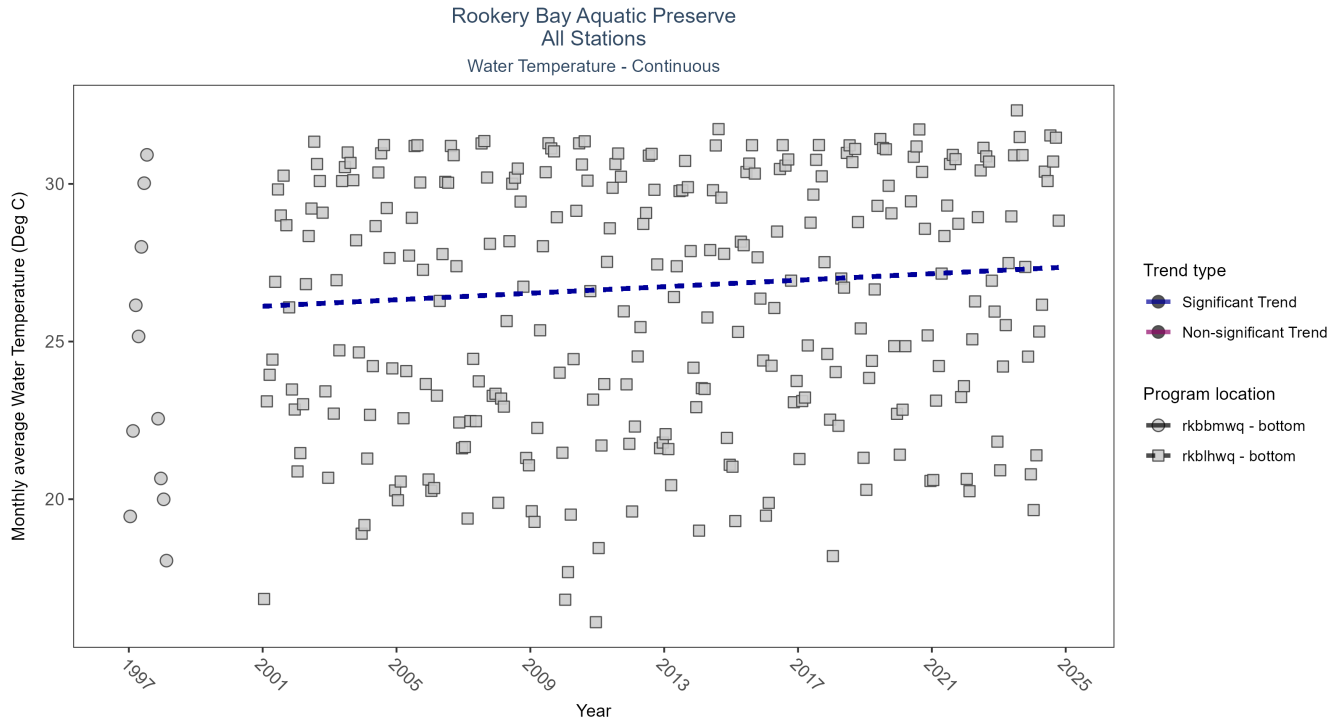


Figure 33: Figure for Water Temperature - Continuous - All stations combined

Table 38: 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	-	-	-	-
rkblhwq	688994	24	2001 - 2024	27.0	0.25	26.12	0.05	0.0000

# 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

Rookery Bay Aquatic Preserve  
 SAV Percent Cover - Sample Locations

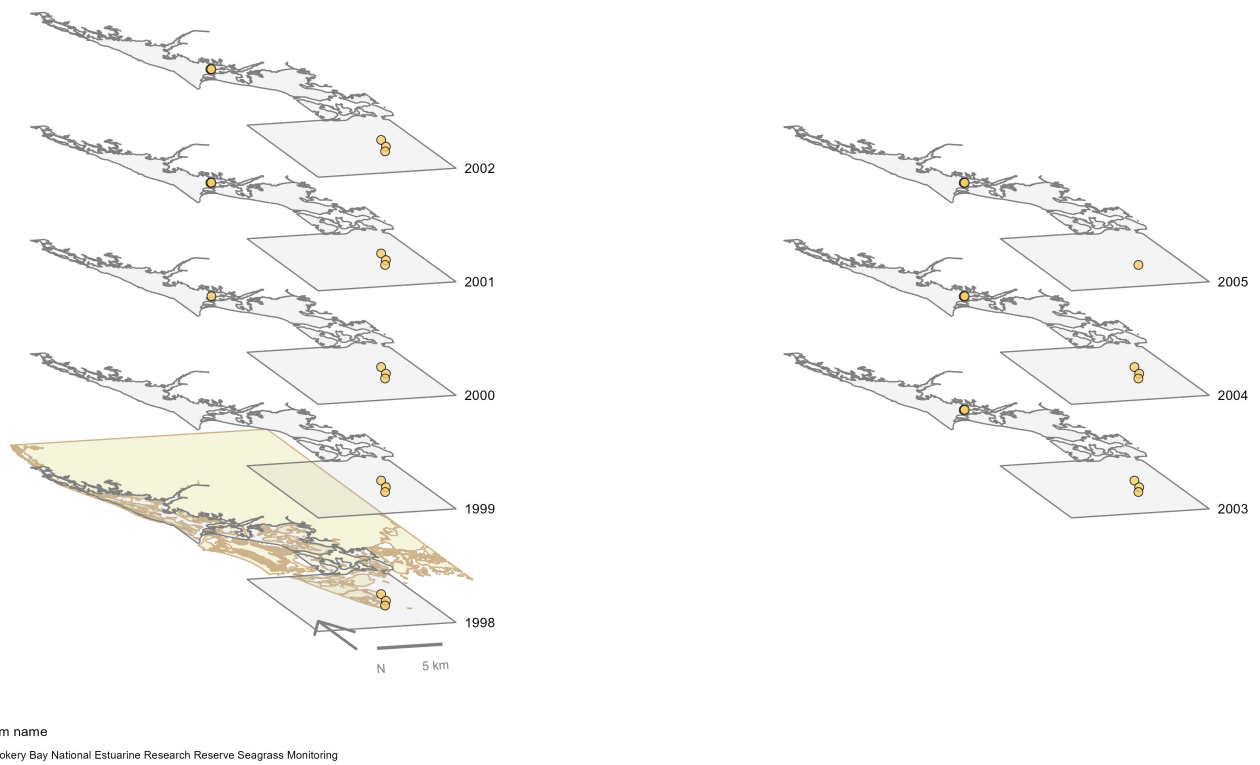


Figure 34: Maps showing the temporal scope of SAV sampling sites within the boundaries of *Rookery Bay Aquatic Preserve* by Program name.

**Sampling locations by Program:**

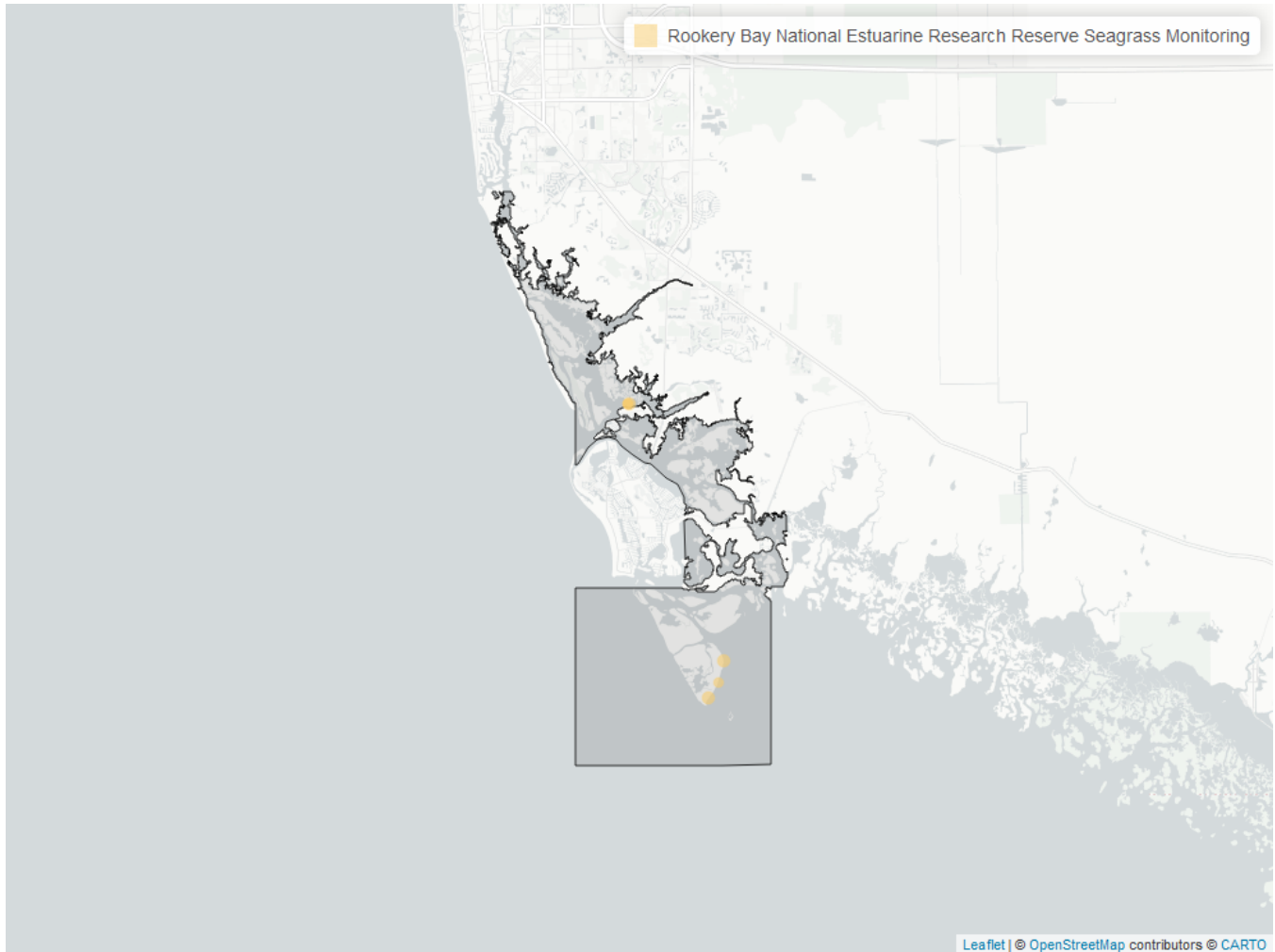


Figure 35: Map showing SAV sampling sites within the boundaries of *Rookery Bay Aquatic Preserve*. The point size reflects the number of samples at a given sampling site.

Table 39: Rookery Bay National Estuarine Research Reserve Seagrass Monitoring - Program 572

<i>N-Data</i>	<i>YearMin</i>	<i>YearMax</i>	<i>method</i>	<i>Sample Locations</i>
1220	1998	2005	Percent Cover	6

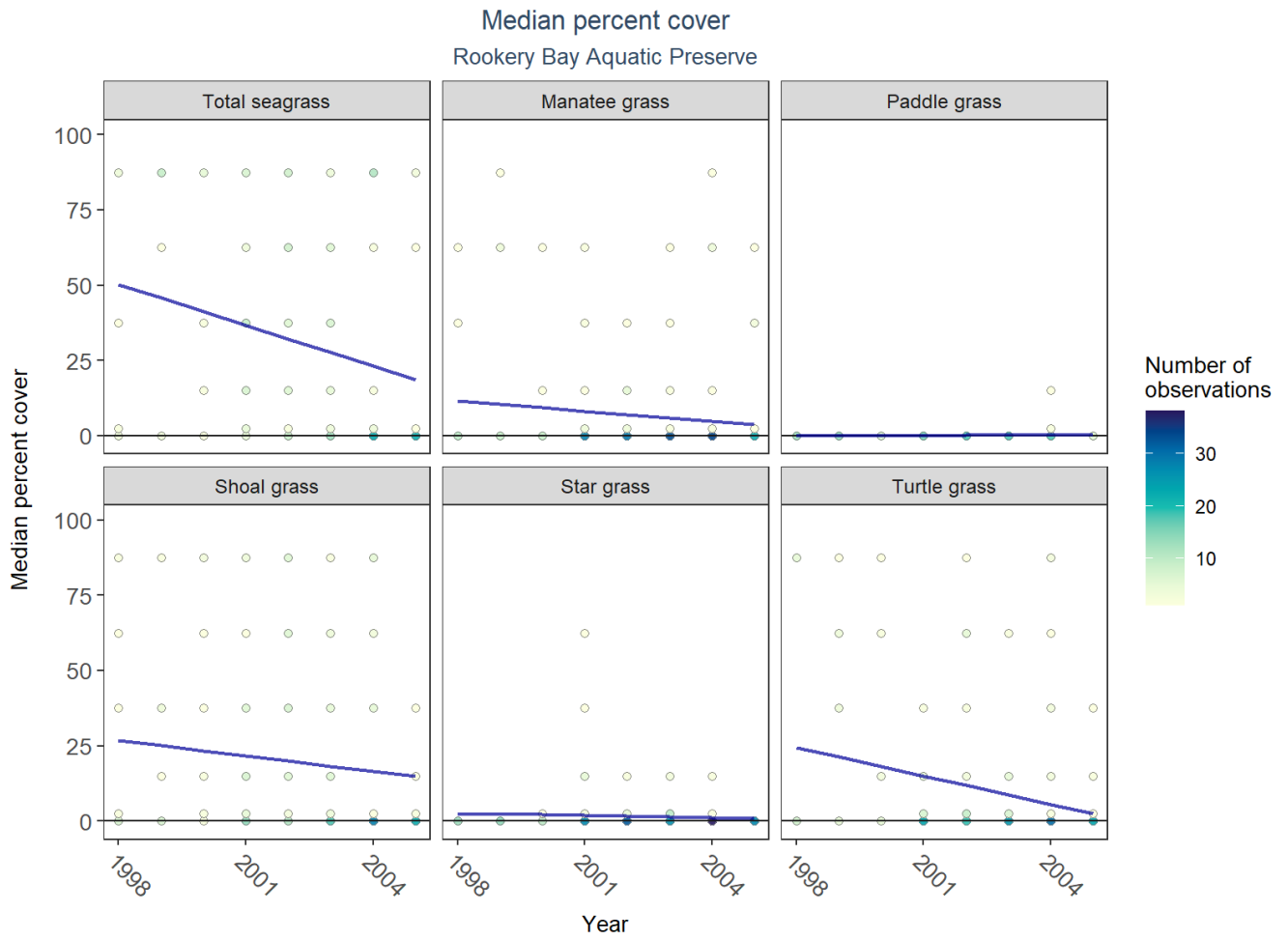


Figure 36: Trends in median percent cover for various seagrass species in Rookery Bay Aquatic Preserve

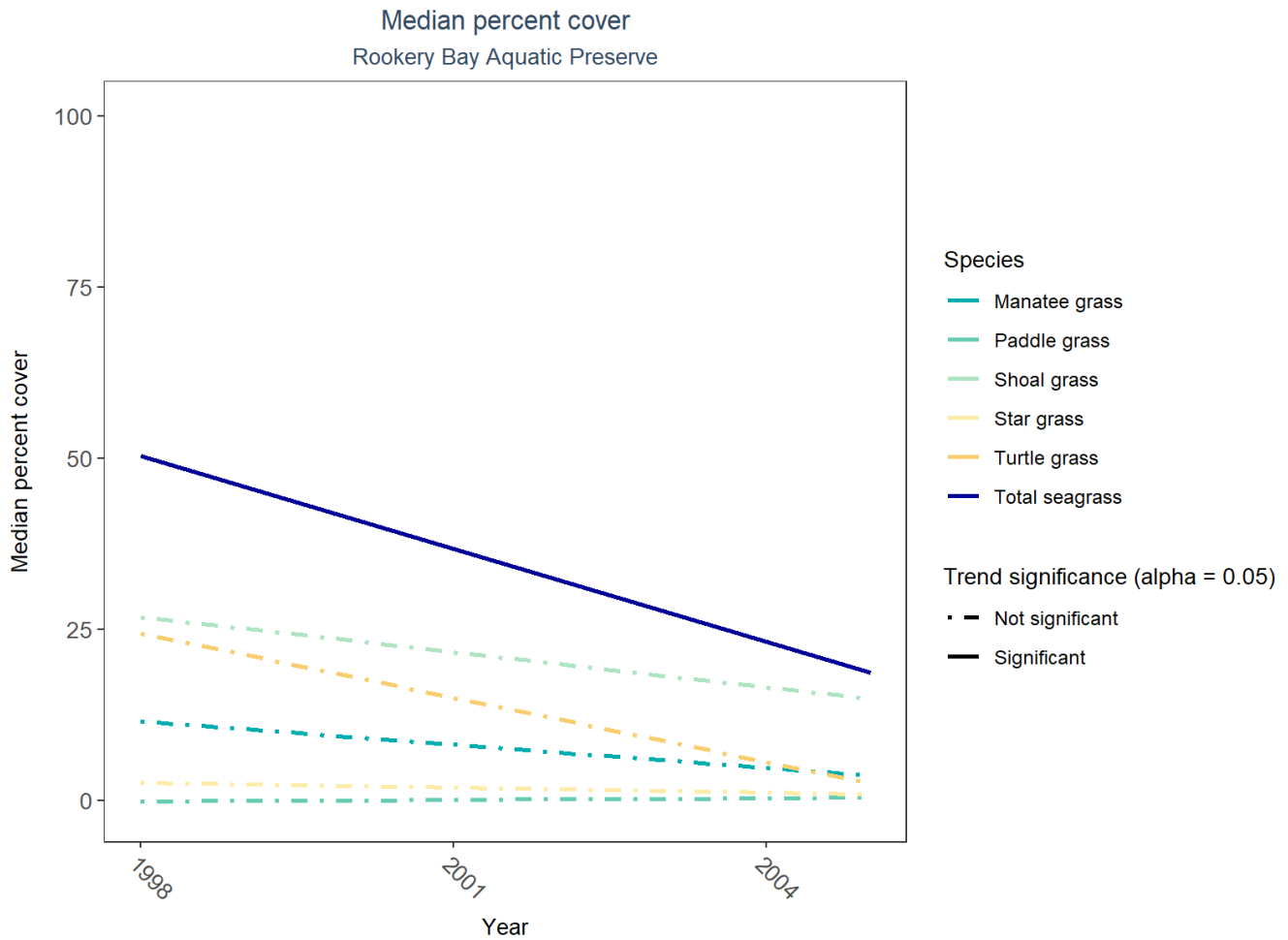


Figure 37: Trends in median percent cover for various seagrass species in Rookery Bay Aquatic Preserve - simplified

Table 40: Percent Cover Trend Analysis for Rookery Bay Aquatic Preserve

<i>CommonName</i>	<i>Trend Significance (0.05)</i>	<i>Period of Record</i>	<i>LME-Intercept</i>	<i>LME-Slope</i>	<i>p</i>
Shoal grass	No significant trend	1998 - 2005	33.6286340	-1.7090948	0.2546137
Paddle grass	No significant trend	1998 - 2005	-0.4445592	0.0784240	0.3562736
Star grass	No significant trend	1998 - 2005	3.5304890	-0.2323278	0.4437183
Manatee grass	No significant trend	1998 - 2005	16.1048066	-1.1343883	0.4000876
Turtle grass	No significant trend	1998 - 2005	36.9898792	-3.1381273	0.0666580
Total seagrass	Significantly decreasing trend	1998 - 2005	68.3695381	-4.5209764	0.0166159

Frequency of occurrence  
Rookery Bay Aquatic Preserve

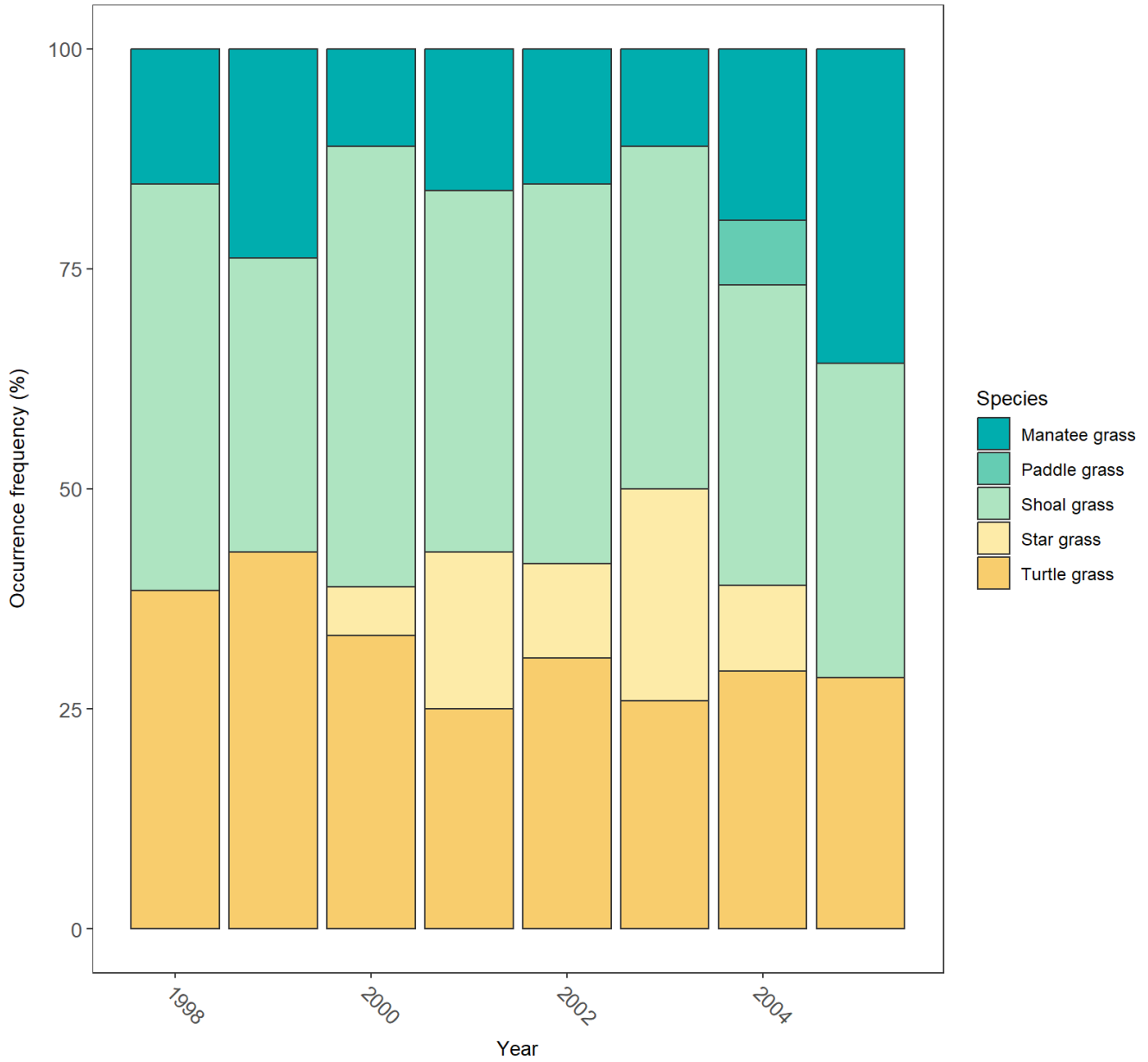


Figure 38: Frequency of occurrence for various seagrass species in Rookery Bay Aquatic Preserve

# Nekton

The data file used is: **All\_NEKTON\_Parameters-2024-Dec-17.txt**

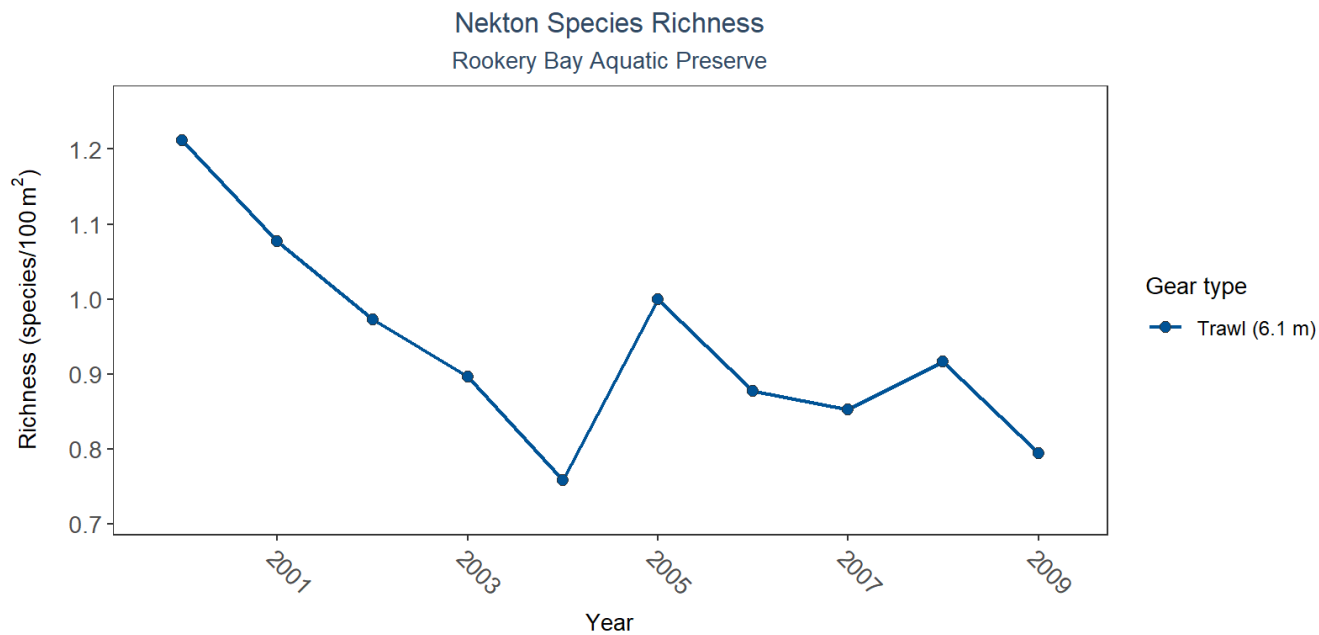


Figure 39: Figure for Nekton Species Richness in Rookery Bay Aquatic Preserve

Table 41: Nekton Species Richness

<i>Gear Type</i>	<i>Sample Count</i>	<i>Number of Years</i>	<i>Period of Record</i>	<i>Median N of Taxa</i>	<i>Mean N of Taxa</i>
Trawl (6.1)	535	10	2000 - 2009	0.94	0.94



## References

1. Sanibel-Captiva Conservation Foundation (SCCF). [River, Estuary and Coastal Observing Network](#). (2024).
2. Florida Department of Environmental Protection (DEP); Office of Resilience and Coastal Protection (RCP); Rookery Bay National Estuarine Research Reserve. [Rookery Bay National Estuarine Research Reserve System-Wide Monitoring Program](#). (2024).
3. Florida Department of Environmental Protection (DEP). [Florida STORET / WIN](#). (2024).
4. U.S. Environmental Protection Agency (EPA). [EPA STORage and RETrieval Data Warehouse \(STORET\)/WQX](#). (2023).
5. Florida International University (FIU); Southeastern Environmental Research Program. [SERC Water Quality Monitoring Network](#). (2008).
6. University of Florida (UF); Institute of Food and Agricultural Sciences. [Florida LAKEWATCH Program](#). (2024).
7. Florida Fish and Wildlife Conservation Commission (FWC). [Fisheries-Independent Monitoring \(FIM\) Program](#). (2022).
8. Florida Fish and Wildlife Conservation Commission (FWC); Florida Fish and Wildlife Research Institute (FWRI). [Harmful Algal Bloom Marine Observation Network](#). (2018).
9. Florida Department of Environmental Protection (DEP); Office of Resilience and Coastal Protection (RCP); Rookery Bay National Estuarine Research Reserve. [Rookery Bay National Estuarine Research Reserve Seagrass Monitoring](#). (2005).
10. Florida Department of Environmental Protection (DEP); Office of Resilience and Coastal Protection (RCP); Rookery Bay National Estuarine Research Reserve. [RBNERR Fish Assessment](#). (2023).