

# Rookery Bay Aquatic Preserve

## SEACAR Habitat Analyses

Last compiled on 14 March, 2024

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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>	<i>Sensor Type</i>
Dissolved Oxygen	mg/L	0	50	YSI EXOs
Dissolved Oxygen	mg/L	0	50	Analysis Only - 2022-04-04
Dissolved Oxygen	mg/L	0	50	6600 Series
Salinity	ppt	0	70	6600 Series
Salinity	ppt	0	70	YSI EXOs
Salinity	ppt	0	70	Analysis Only - 2022-04-04
Water Temperature	Degrees C	-5	45	YSI EXOs
Water Temperature	Degrees C	-5	45	Analysis Only - 2022-04-04
Water Temperature	Degrees C	-5	45	6600 Series
pH	pH	2	14	Analysis Only - 2022-04-04
pH	pH	2	14	6600 Series
pH	pH	2	14	YSI EXOs
Dissolved Oxygen Saturation	%	0	500	YSI EXOs
Dissolved Oxygen Saturation	%	0	500	6600 Series
Dissolved Oxygen Saturation	%	0	500	Analysis Only - 2022-04-04
Specific Conductivity	mS/cm	0	100	6600 Series
Specific Conductivity	mS/cm	0	200	YSI EXOs
Turbidity	NTU	0	4000	YSI EXOs
Turbidity	NTU	0	1000	6600 Series
Turbidity	NTU	0	4000	Analysis Only - 2022-04-04

Table 2: Discrete 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	22
Salinity	ppt	0	70
Water Temperature	Degrees C	3	40
pH		2	13
Dissolved Oxygen Saturation	%	0.000001	310
Specific Conductivity	mS/cm	0.005000001	100
Turbidity	NTU	0	-
Total Suspended Solids (TSS)	mg/L	0	-
Chlorophyll a uncorrected for pheophytin	ug/L	0	-
Chlorophyll a corrected for pheophytin	ug/L	0	-
Secchi Depth	m	0.000001	50
Light Extinction Coefficient	$m^{-1}$	0	-
Colored dissolved organic matter, CDOM	PCU	0	-
Fluorescent dissolved organic matter, FDOM	QSE	0	-
Total Nitrogen	mg/L	0	-
Total Kjeldahl Nitrogen TKN	mg/L	0	-
NO <sub>2</sub> +3 Filtered	mg/L	0	-
NH <sub>4</sub> Filtered	mg/L	0	-
Total Phosphorus	mg/L	0	-

Parameter Name	Units	Low Threshold	High Threshold
PO4 Filtered	mg/L	0	-
Ammonia- Un-ionized (NH3)	mg/L	0	-
Nitrate (N)	mg/L	0	-
Nitrite (N)	mg/L	0	-
Nitrogen, organic	mg/L	0	-

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

SEACAR QAQC Description	Include	SEACAR QAQCFlagCode
Exceeds Maximum threshold. Not verified in raw data	No	2Q
Exceeds Maximum threshold. Verified in raw data	No	3Q
Below Minimum threshold. Not verified in raw data	No	4Q
Below Minimum threshold. Verified in raw data	No	5Q
Within threshold tolerance	Yes	6Q
No defined thresholds for this parameter	Yes	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	No	0	Value based on field kit determination; results may not be accurate
STORET-WIN	J	No	0	Estimated value
STORET-WIN	V	No	0	Analyte was detected at or above method detection limit
STORET-WIN	Y	No	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 surface of all water bodies to the bottom sediments and encompasses the different features found in the water at different depths (National Oceanographic Center, 2016). The water column habitat must be viewed in relation to its interconnectedness with other habitats. A healthy water column is an integral component in ensuring a healthy marine and coastal ecosystem. Having a flourishing marine and coastal ecosystem in Florida is necessary to support a strong economy. The health of the water column is dependent upon factors as diverse as land use (e.g., agriculture, mining, forestry practices); human population growth; emissions, (e.g., power plants, automobiles, wastewater); climate (e.g., rainfall, temperature, winds and currents); and decadal trends (e.g., El Niño/La Niña, Atlantic Multidecadal Oscillation, climate change).

The water column is composed of various physical, chemical and biological features, and only a small number of them are adequately monitored. Features of the water column that are monitored are used as indicators of the water column health and help assess the status of other habitats. These indicators include nutrient concentrations (nitrogen and phosphorus); water quality (dissolved oxygen, temperature, salinity and pH); water clarity (Secchi depth, turbidity, chlorophyll-a and colored dissolved organic matter); and nekton (fish, macroinvertebrates and megafauna).

## 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**.

## Water Quality - Discrete

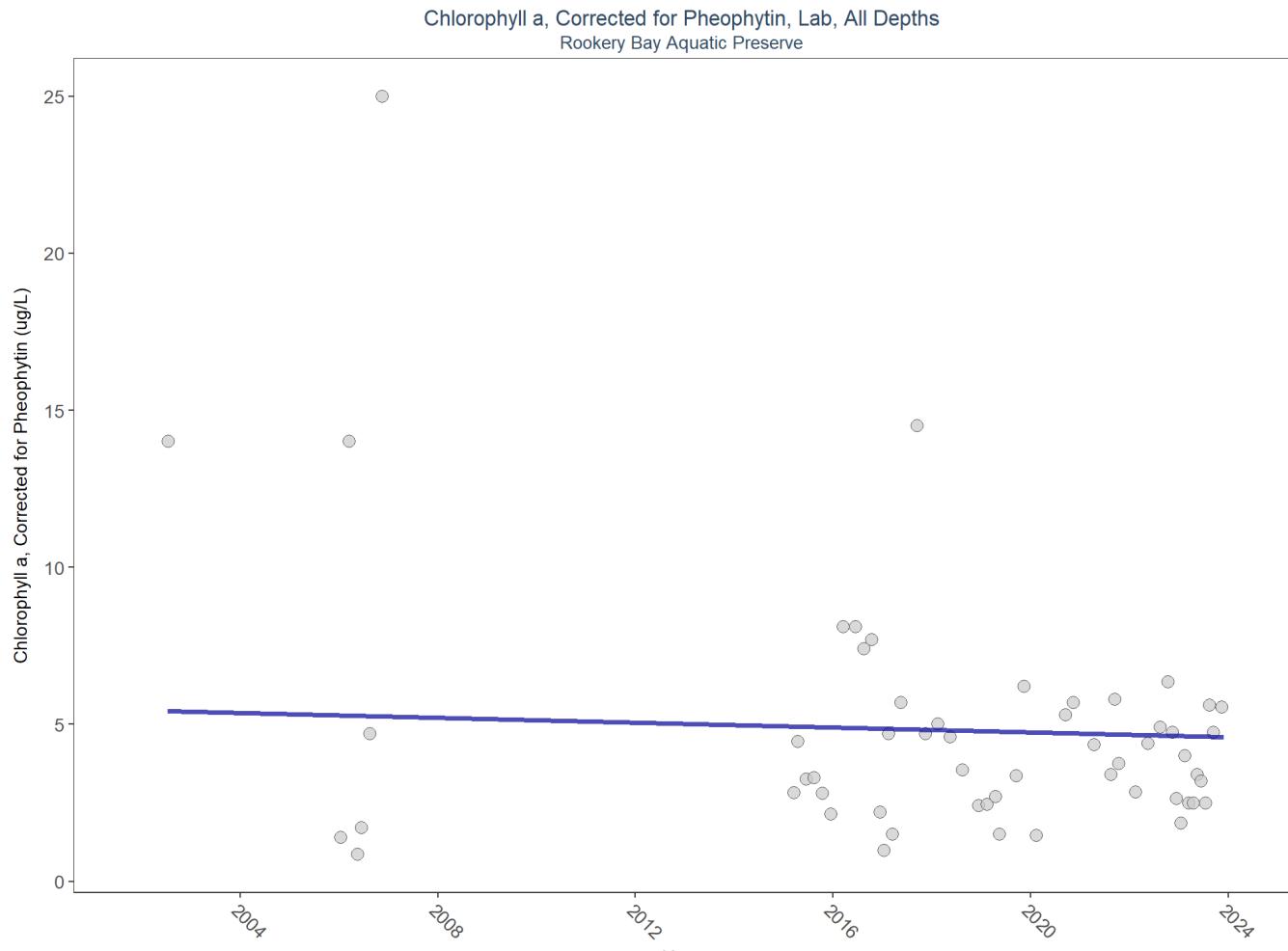
The following files were used in the discrete analysis:

- *Combined\_WQ\_WC\_NUT\_Chlorophyll\_a\_corrected\_for\_pheophytin-2024-Feb-22.txt*
- *Combined\_WQ\_WC\_NUT\_Chlorophyll\_a\_uncorrected\_for\_pheophytin-2024-Feb-22.txt*
- *Combined\_WQ\_WC\_NUT\_Colored\_dissolved\_organic\_matter\_CDOM-2024-Feb-22.txt*
- *Combined\_WQ\_WC\_NUT\_Dissolved\_Oxygen-2024-Feb-22.txt*
- *Combined\_WQ\_WC\_NUT\_Dissolved\_Oxygen\_Saturation-2024-Feb-22.txt*
- *Combined\_WQ\_WC\_NUT\_pH-2024-Feb-22.txt*
- *Combined\_WQ\_WC\_NUT\_Salinity-2024-Feb-22.txt*
- *Combined\_WQ\_WC\_NUT\_Secchi\_Depth-2024-Feb-22.txt*
- *Combined\_WQ\_WC\_NUT\_Total\_Nitrogen-2024-Feb-22.txt*
- *Combined\_WQ\_WC\_NUT\_Total\_Phosphorus-2024-Feb-22.txt*
- *Combined\_WQ\_WC\_NUT\_Total\_Suspended\_Solids\_TSS-2024-Feb-22.txt*
- *Combined\_WQ\_WC\_NUT\_Turbidity-2024-Feb-22.txt*
- *Combined\_WQ\_WC\_NUT\_Water\_Temperature-2024-Feb-22.txt*

## Chlorophyll a, Corrected for Pheophytin - Discrete Water Quality

Chlorophyll-a is monitored as a measure of microalgae growing in the water. Algae are a natural part of coastal and aquatic ecosystems but in excess can cause poor water quality and clarity, and decreased levels of dissolved oxygen.

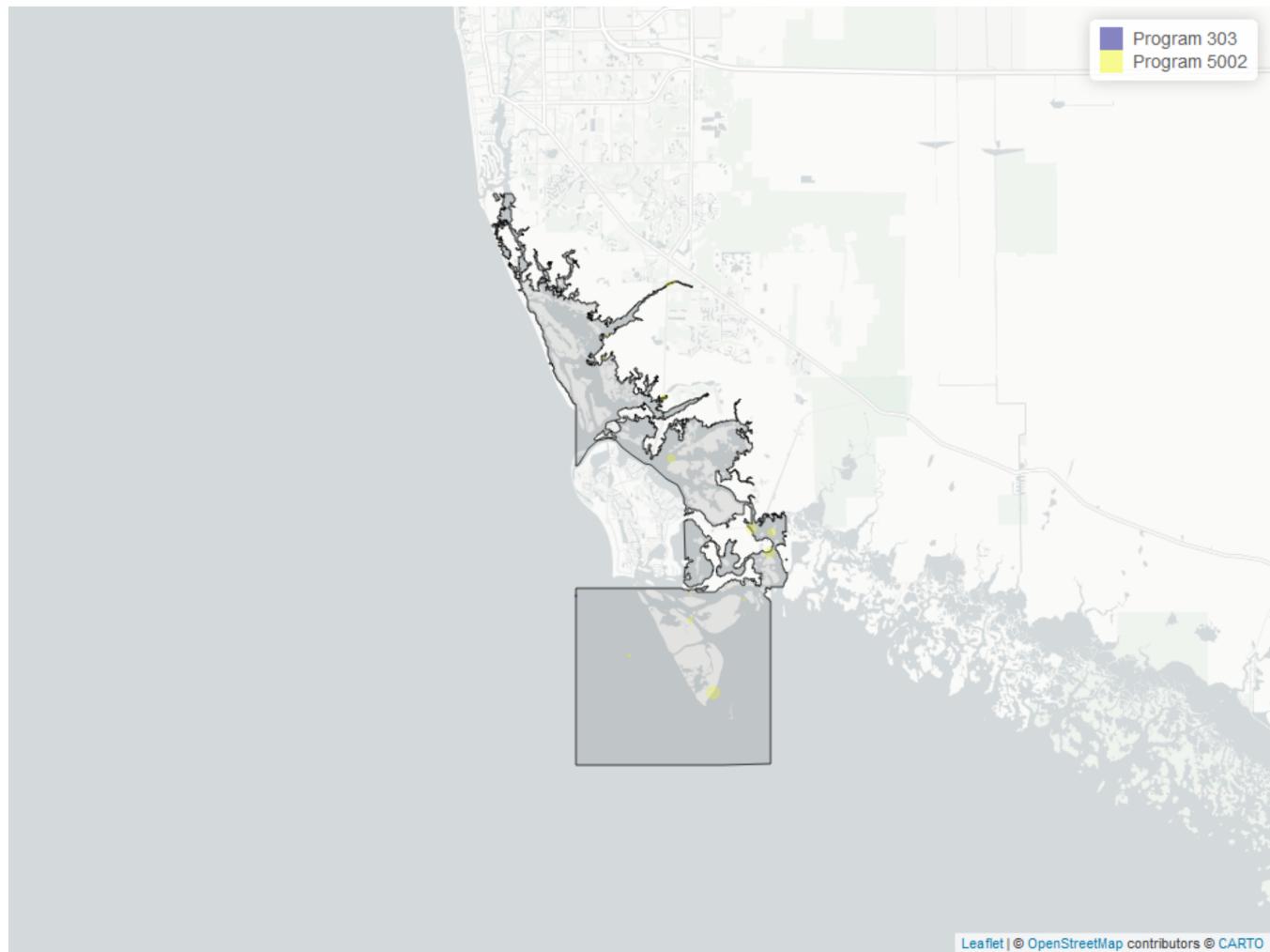
### Seasonal Kendall-Tau Trend Analysis



*p < 0.00005 appear as 0 due to rounding.*

*SennIntercept is intercept value at beginning of record for monitoring location*

Map showing location of Discrete sampling sites for Chlorophyll a, Corrected for Pheophytin



The bubble size on the above plots reflects the amount of data available at each sampling site

Table 6: Programs contributing data for Chlorophyll a, Corrected for Pheophytin

ProgramID	N_Data	YearMin	YearMax
5002	93	2002	2023
303	2	2022	2023

#### Program names:

5002 - Florida STORET / WIN

303 - River, Estuary and Coastal Observing Network

#### Value Qualifiers

- $N_{Total}$  is total amount of data for a given year
- $N_{\_}$  is the total amount of values flagged with the respective value qualifier in a given year

- *perc\_* is the percent of data flagged with the respective value qualifier as a proportion of *N\_Total*

Table 7: Value Qualifiers for Chlorophyll a, Corrected for Pheophytin

<i>Year</i>	<i>N_Total</i>	<i>N_I</i>	<i>perc_I</i>	<i>N_Q</i>	<i>perc_Q</i>	<i>N_U</i>	<i>perc_U</i>
2006	6					3	50.0
2015	19	2	10.5				
2017	8	2	25.0	1	12.5		
2019	8	2	25.0				
2020	4	2	50.0				
2021	7	1	14.3				
2022	14	1	7.1	2	14.3	1	7.1
2023	15	2	13.3			4	26.7

**Note:** <sup>1</sup>**I** - Reported value is greater than or equal to lab method detection limit, but less than quantitation limit <sup>2</sup>**Q**  
 - Sample held beyond the accepted holding time <sup>3</sup>**U** - Compound was analyzed for but not detected

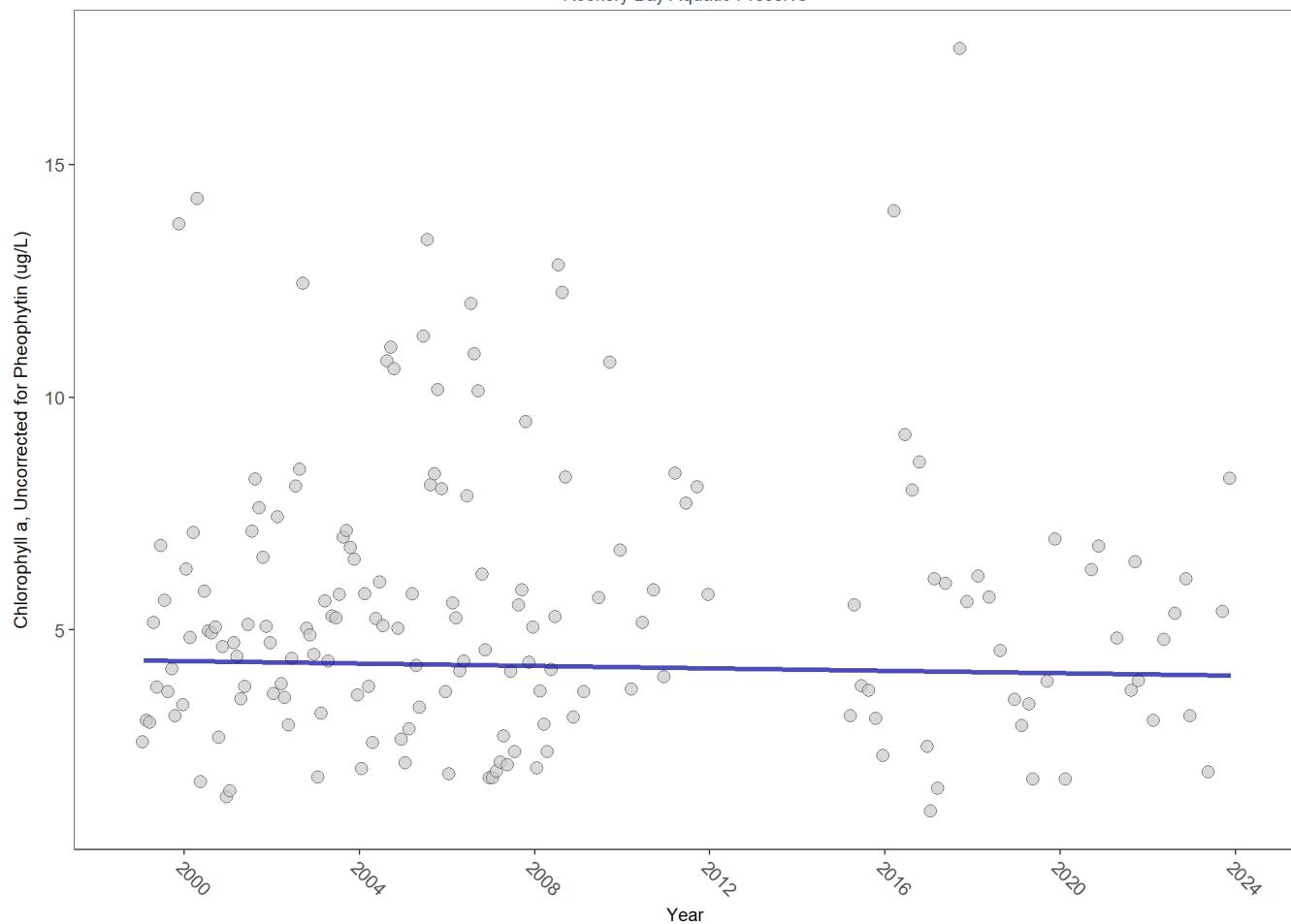
**Programs containing Value Qualified data:**

5002 - Florida STORET / WIN

# Chlorophyll a, Uncorrected for Pheophytin - Discrete Water Quality

## Seasonal Kendall-Tau Trend Analysis

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



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	1701	22	4.5625	TRUE	-0.0332	0.5508	-0.01336667	4.350806	6.4674	0.8404	0

*p < 0.00005 appear as 0 due to rounding.*

*SennIntercept is intercept value at beginning of record for monitoring location*

Map showing location of Discrete sampling sites for Chlorophyll a, Uncorrected for Pheophytin

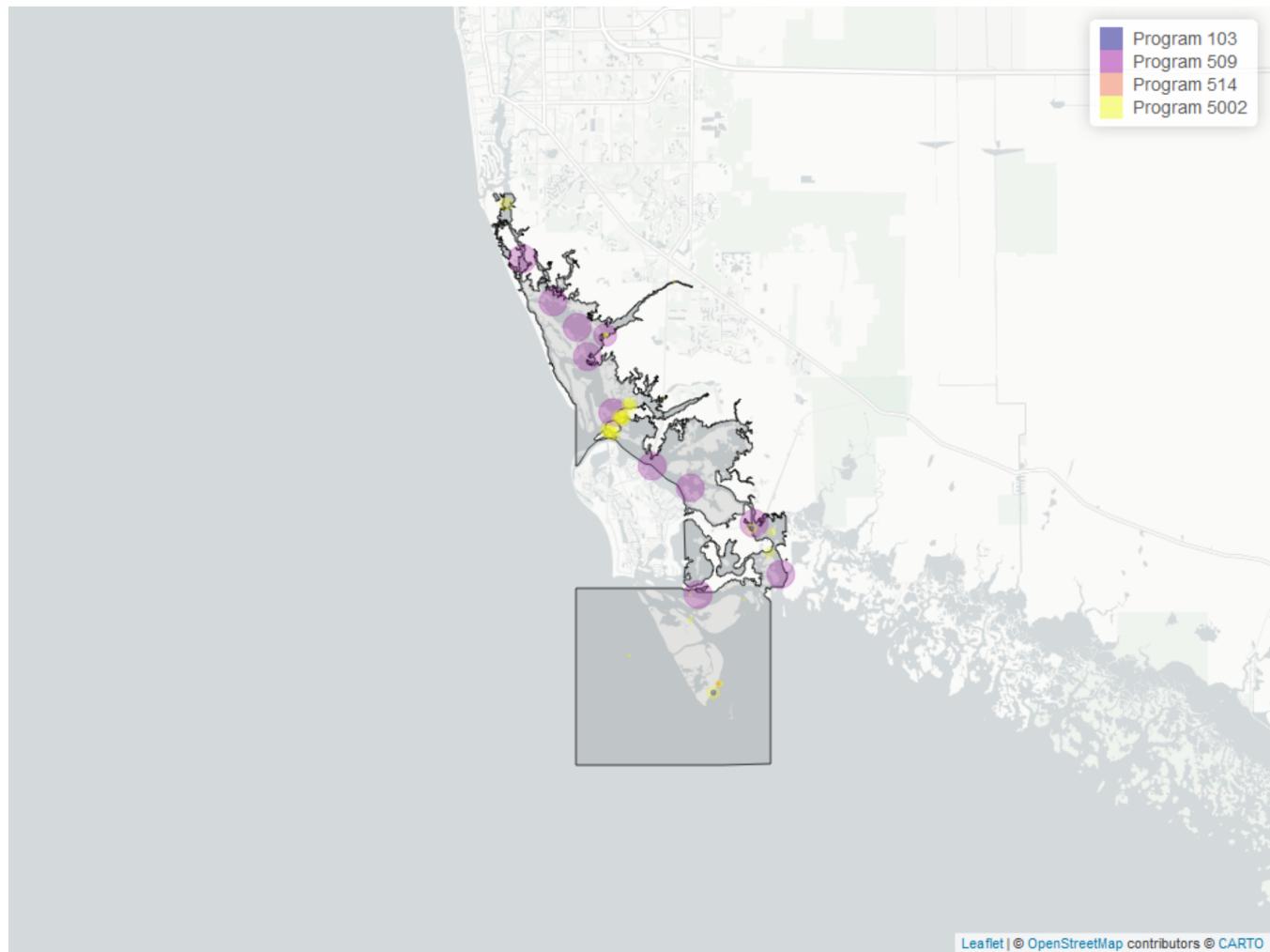


Table 8: Programs contributing data for Chlorophyll a, Uncorrected for Pheophytin

ProgramID	N_Data	YearMin	YearMax
509	1234	1999	2008
5002	453	2001	2023
103	11	2021	2021
514	4	2001	2003

#### Program names:

509 - SERC Water Quality Monitoring Network

5002 - Florida STORET / WIN

103 - EPA STOrage and RETrieval Data Warehouse (STORET)

514 - Florida LAKEWATCH Program

## Value Qualifiers

- $N_{Total}$  is total amount of data for a given year
- $N_{}$  is the total amount of values flagged with the respective value qualifier in a given year
- $perc_{}$  is the percent of data flagged with the respective value qualifier as a proportion of  $N_{Total}$

Table 9: Value Qualifiers for Chlorophyll a, Uncorrected for Pheophytin

Year	$N_{Total}$	$N_I$	$perc_I$	$N_Q$	$perc_Q$
2015	19	1	5.3		
2017	8	1	12.5	1	12.5
2019	8	2	25.0		
2020	4	1	25.0		
2022	10	1	10.0	2	20.0
2023	6	1	16.7		

**Note:** <sup>1</sup>I - Reported value is greater than or equal to lab method detection limit, but less than quantitation limit <sup>2</sup>Q  
- Sample held beyond the accepted holding time

## Programs containing Value Qualified data:

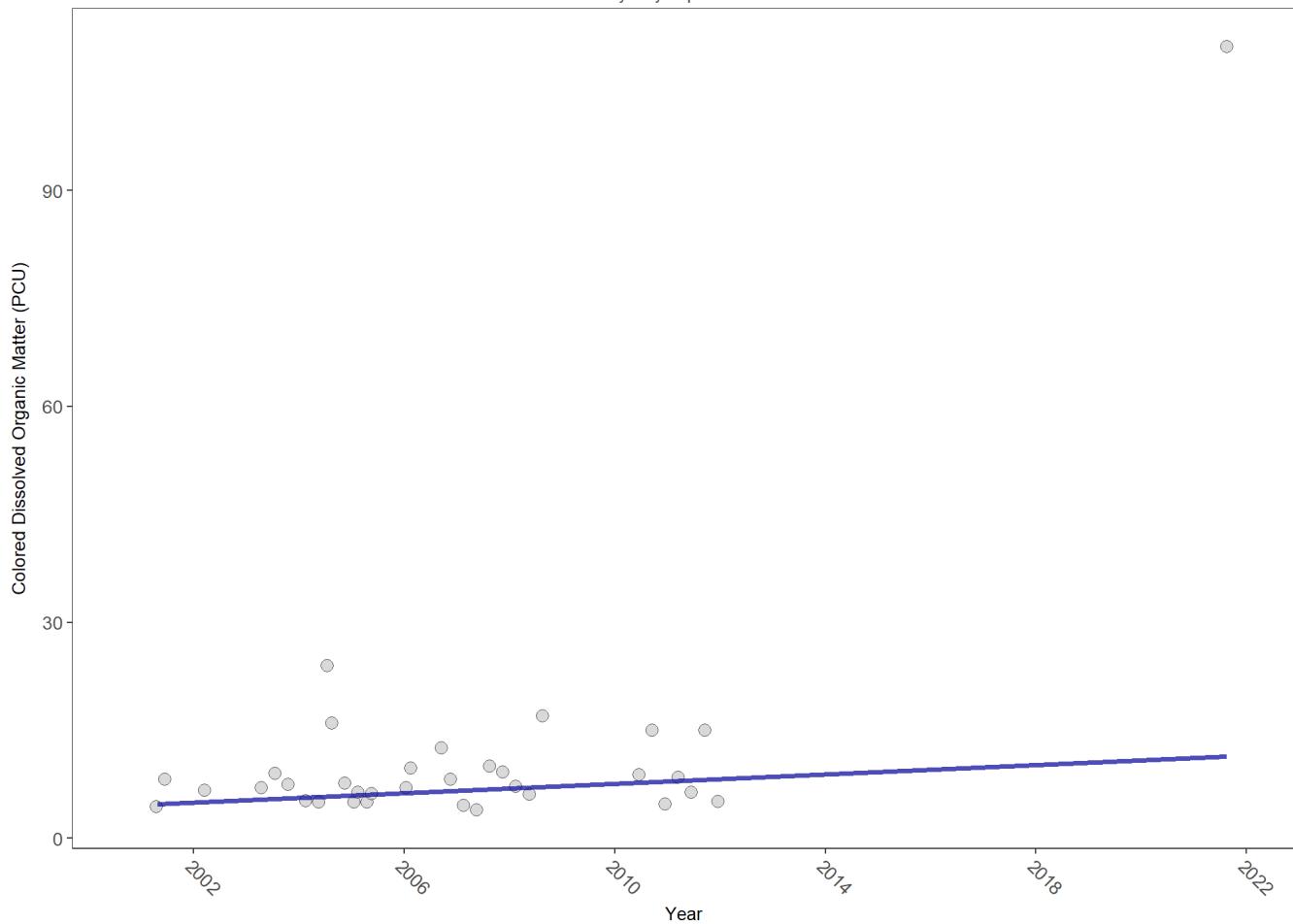
5002 - Florida STORET / WIN

## Colored Dissolved Organic Matter - Discrete Water Quality

**Colored Dissolved Organic Matter (CDOM)** occurs naturally in every water body. It is made up of mainly plant material, algae and bacteria. The composition is determined by its source; plants, soil, algae, and wastewater are common sources.

## Seasonal Kendall-Tau Trend Analysis

Colored Dissolved Organic Matter, Lab, All Depths  
Rookery Bay Aquatic Preserve

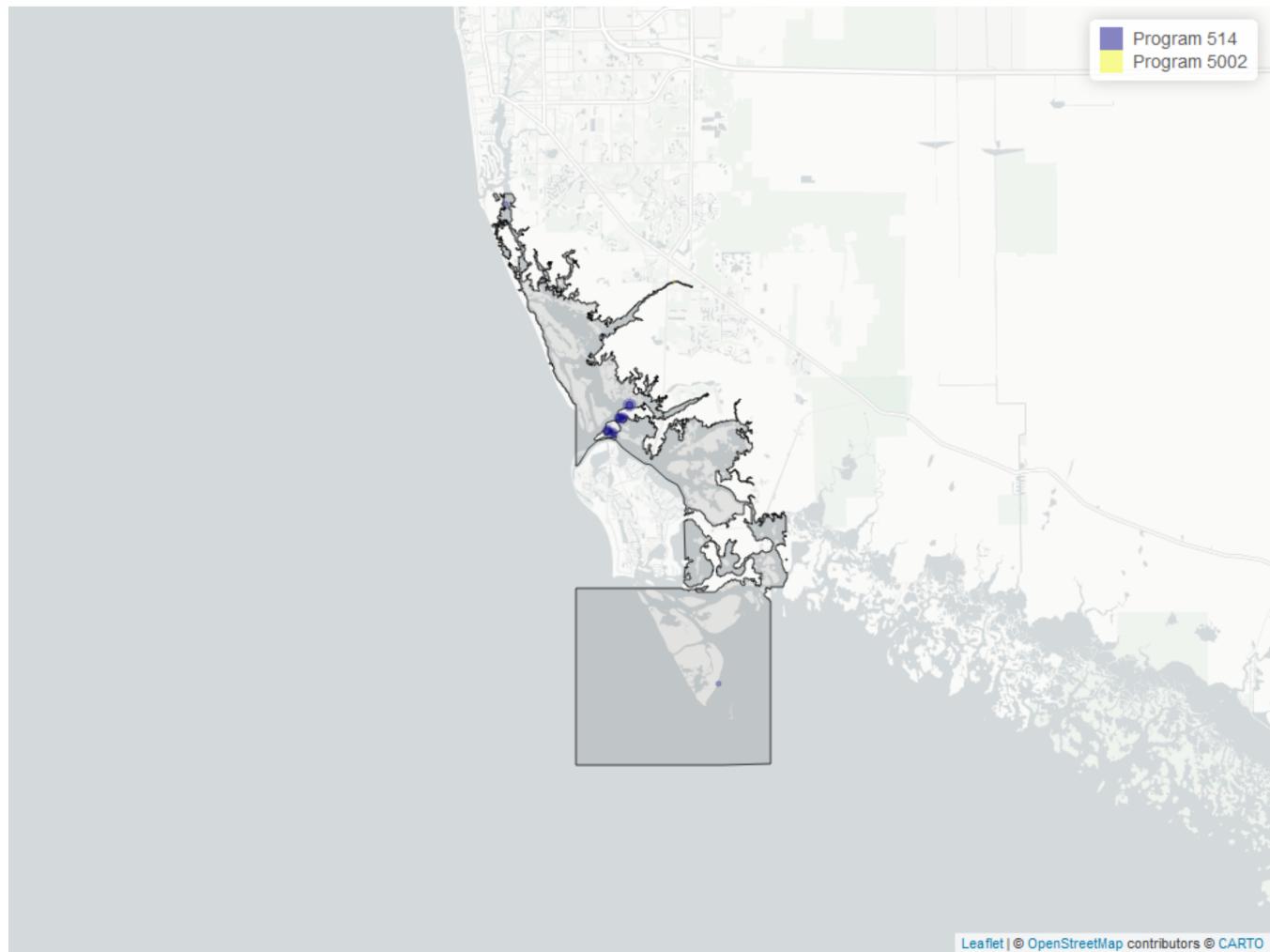


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	183	11	7	TRUE	0.5051	0.0515	0.325	4.7	3.7997	0.9559	0

*p < 0.00005 appear as 0 due to rounding.*

*SennIntercept is intercept value at beginning of record for monitoring location*

Map showing location of Discrete sampling sites for Colored Dissolved Organic Matter



The bubble size on the above plots reflects the amount of data available at each sampling site

Table 10: Programs contributing data for Colored Dissolved Organic Matter

ProgramID	N_Data	YearMin	YearMax
514	182	2001	2011
5002	1	2021	2021

#### Program names:

514 - Florida LAKEWATCH Program

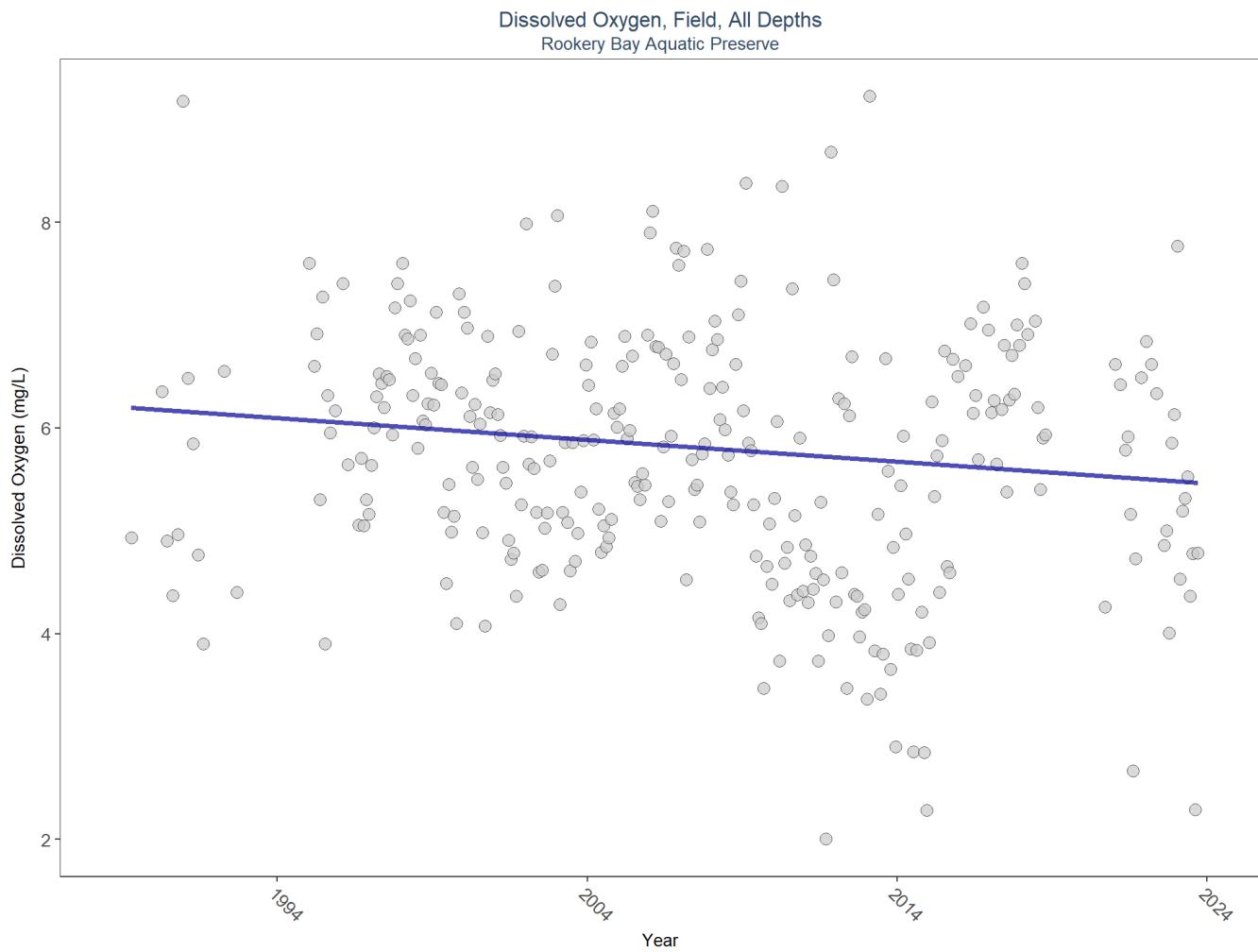
5002 - Florida STORET / WIN

There are no qualifying Value Qualifiers for Colored Dissolved Organic Matter in Rookery Bay Aquatic Preserve

## Dissolved Oxygen - Discrete Water Quality

**Dissolved Oxygen (DO)** is a key indicator of water quality. Oxygen enters surface waters by air-sea gas exchange, by wind action, or as a byproduct of aquatic plant photosynthesis. The actual quantity of DO in aquatic environments is dependent on the above processes as well as water temperature and salinity.

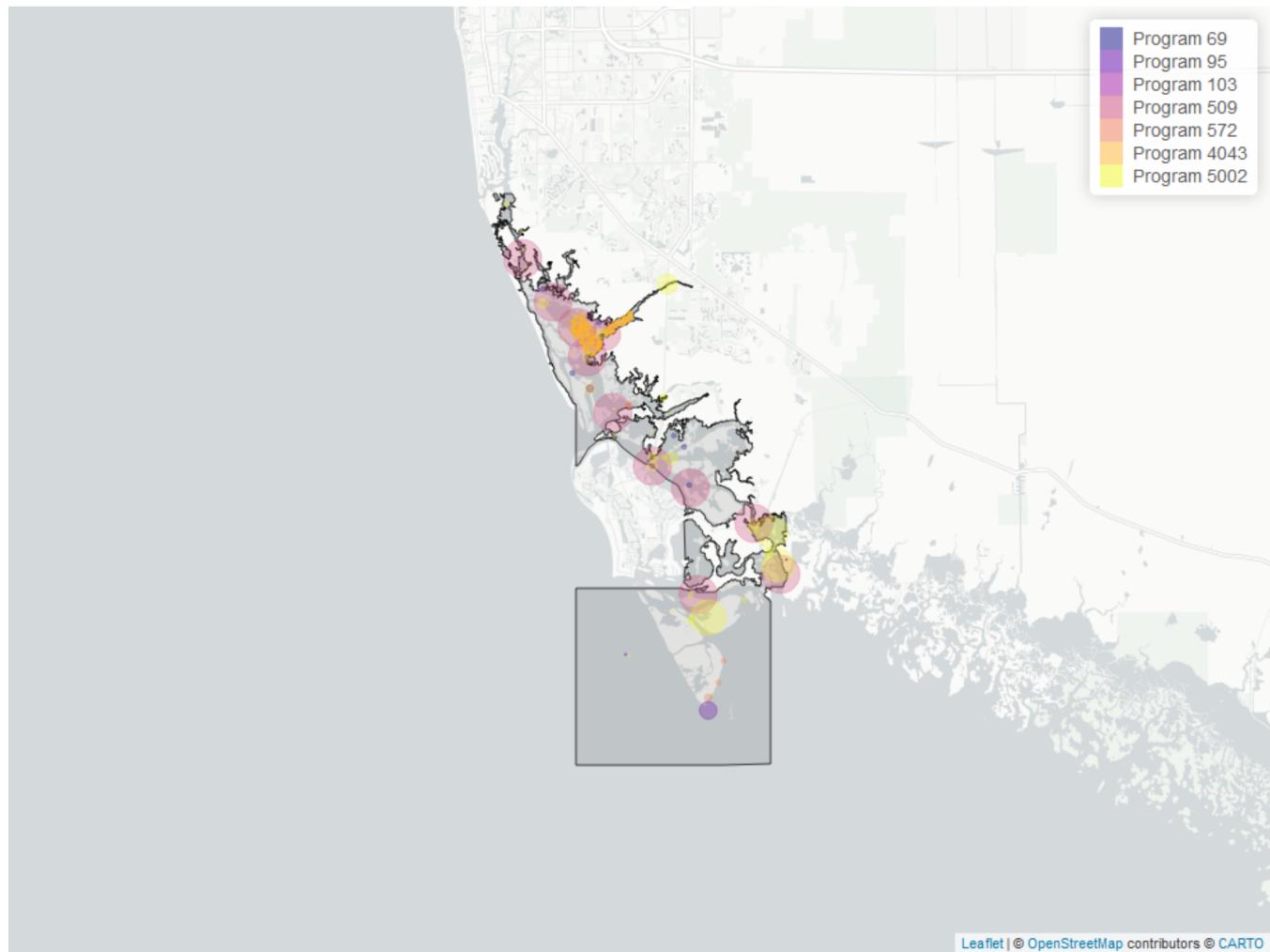
### Seasonal Kendall-Tau Trend Analysis



*p < 0.00005 appear as 0 due to rounding.*

*SennIntercept is intercept value at beginning of record for monitoring location*

Map showing location of Discrete sampling sites for Dissolved Oxygen



The bubble size on the above plots reflects the amount of data available at each sampling site

Table 11: Programs contributing data for Dissolved Oxygen

ProgramID	N_Data	YearMin	YearMax
509	2429	1999	2008
5002	819	1989	2023
4043	488	2000	2009
95	51	1997	2018
103	32	2021	2021
572	27	1998	2005
69	22	2001	2001

**Program names:**

509 - SERC Water Quality Monitoring Network

5002 - Florida STORET / WIN

4043 - RBNERR Fish Assessment

95 - Harmful Algal Bloom Marine Observation Network

103 - EPA STOrage and RETrieval Data Warehouse (STORET)

572 - Rookery Bay National Estuarine Research Reserve Seagrass Monitoring

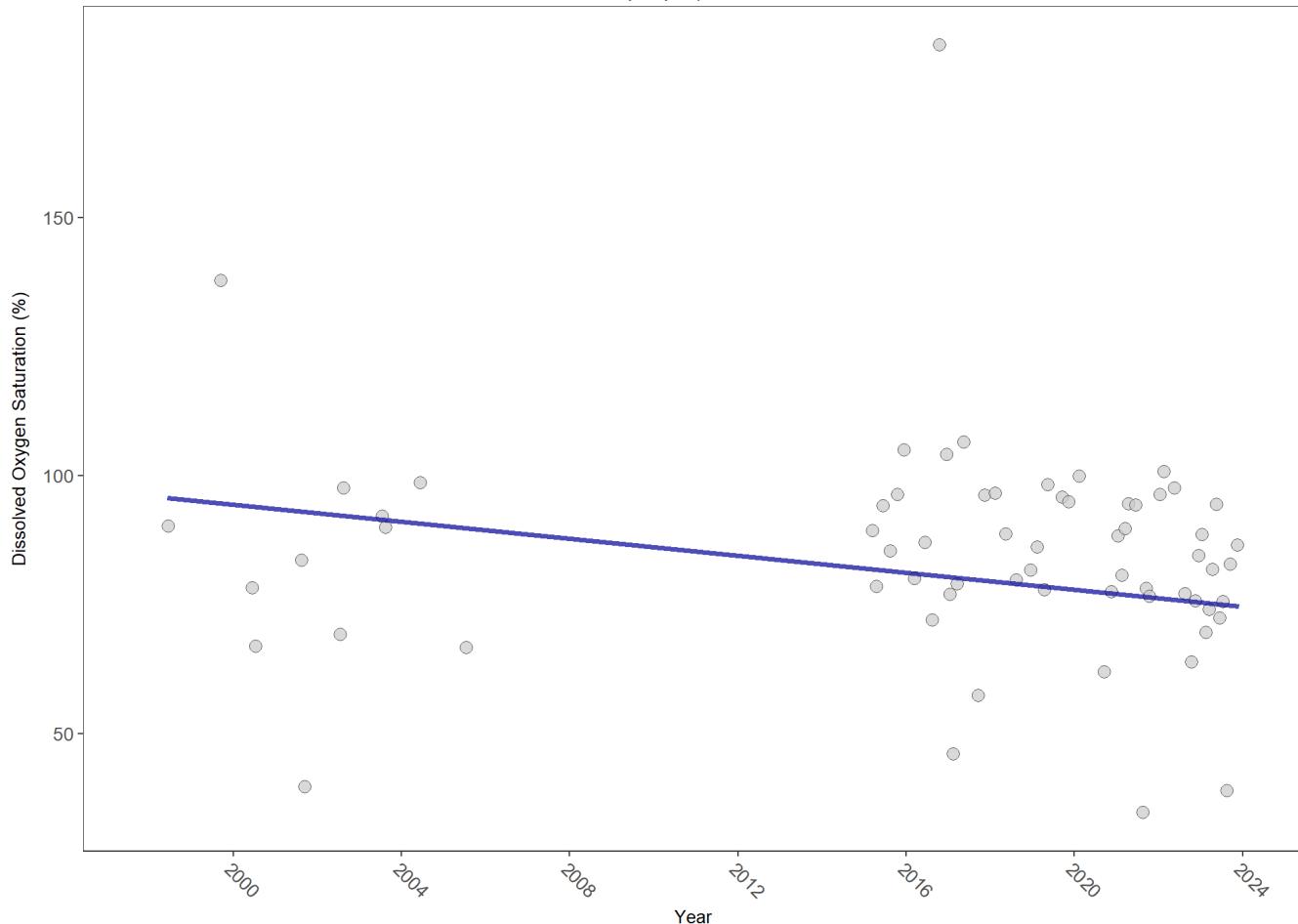
69 - Fisheries-Independent Monitoring (FIM) Program

There are no qualifying Value Qualifiers for Dissolved Oxygen in Rookery Bay Aquatic Preserve

## Dissolved Oxygen Saturation - Discrete Water Quality

### Seasonal Kendall-Tau Trend Analysis

Dissolved Oxygen Saturation, Field, All Depths  
Rookery Bay Aquatic Preserve

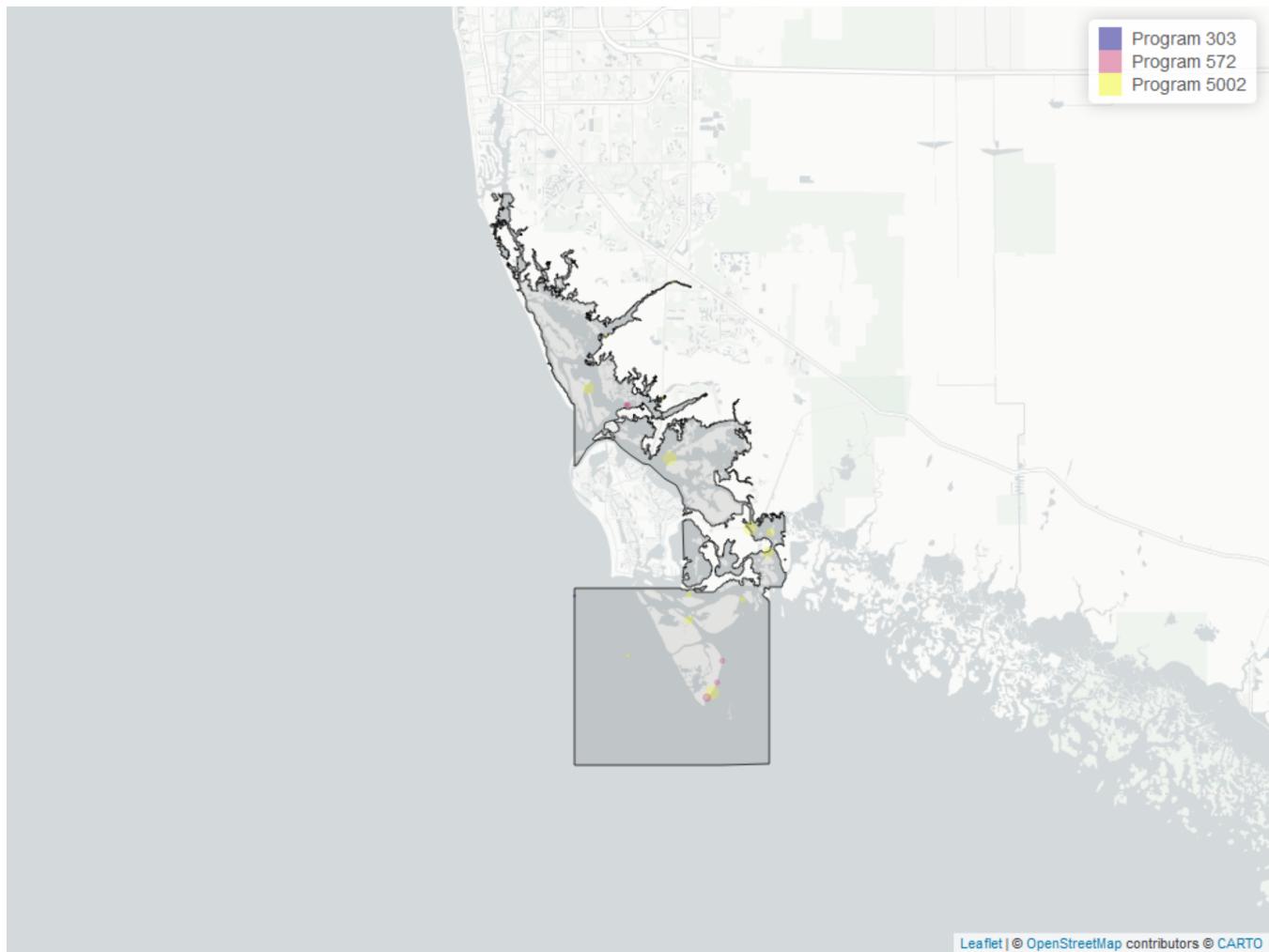


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	154	17	87	TRUE	-0.1793	0.0765	-0.825	96.06491	13.7039	0.2498	0

$p < 0.00005$  appear as 0 due to rounding.

SennIntercept is intercept value at beginning of record for monitoring location

Map showing location of Discrete sampling sites for Dissolved Oxygen Saturation



The bubble size on the above plots reflects the amount of data available at each sampling site

Table 12: Programs contributing data for Dissolved Oxygen Saturation

ProgramID	N_Data	YearMin	YearMax
5002	126	2015	2023
572	27	1998	2005
303	1	2023	2023

#### Program names:

5002 - Florida STORET / WIN

572 - Rookery Bay National Estuarine Research Reserve Seagrass Monitoring

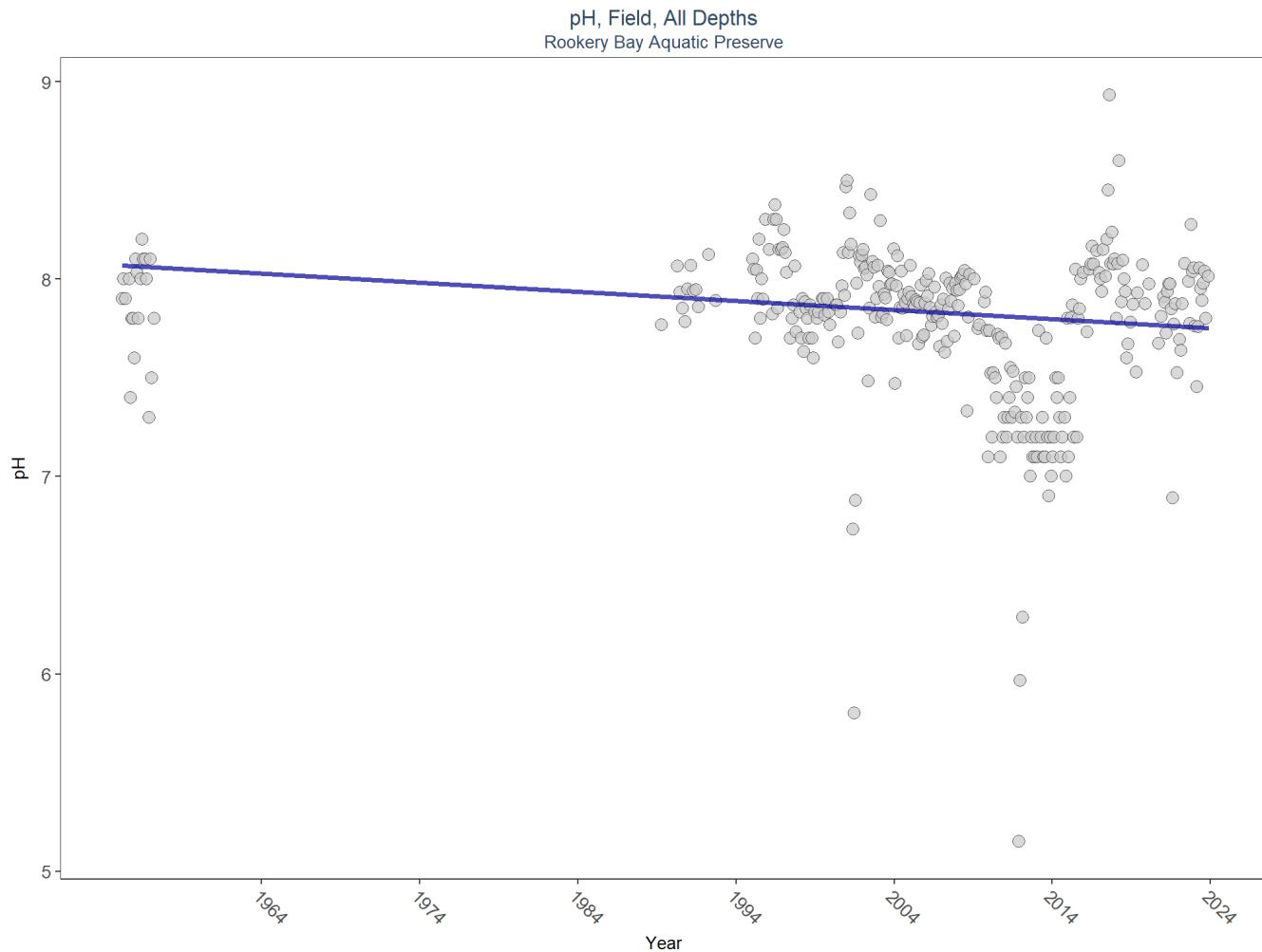
303 - River, Estuary and Coastal Observing Network

There are no qualifying Value Qualifiers for Dissolved Oxygen Saturation in Rookery Bay Aquatic Preserve

## pH - Discrete Water Quality

The **pH** of water is the measure of how acidic or basic the water body is on a scale of 0-14, with lower readings indicating acidic and higher readings indicating basic, and a pH of 7 being neutral. Florida's natural waters fall between 6.5 and 8.5 on this scale. A water body's pH can change due to precipitation, geology, vegetation, water pollution and air pollution.

### Seasonal Kendall-Tau Trend Analysis

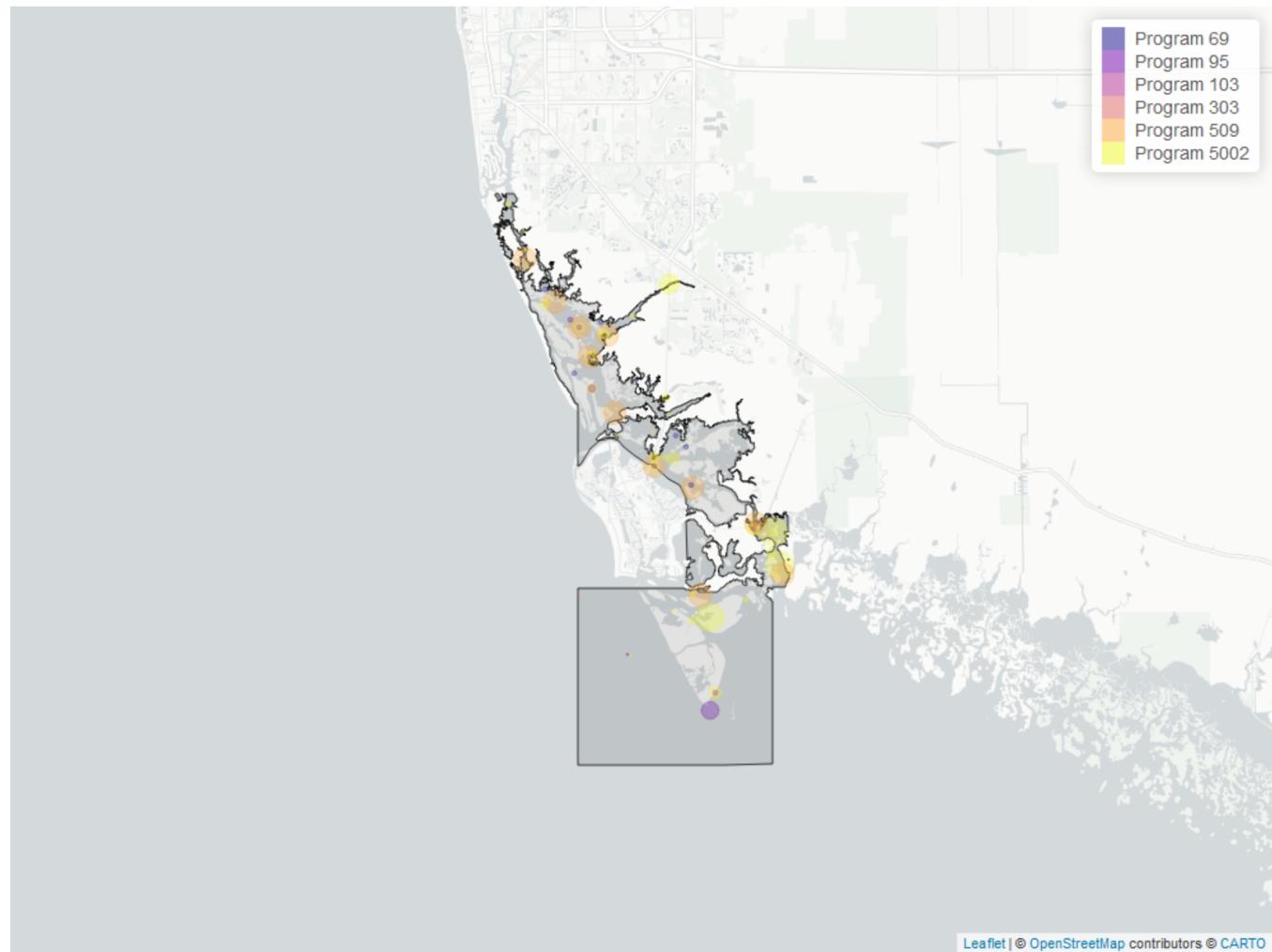


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	1849	36	7.9	TRUE	-0.1618	0.0000	-0.004626866	8.070469	10.0275	0.5279	-1

*p < 0.00005 appear as 0 due to rounding.*

*SennIntercept is intercept value at beginning of record for monitoring location*

Map showing location of Discrete sampling sites for pH



The bubble size on the above plots reflects the amount of data available at each sampling site

Table 13: Programs contributing data for pH

ProgramID	N_Data	YearMin	YearMax
509	971	2001	2008
5002	741	1989	2023
95	76	1955	2018
103	40	2021	2021
69	22	2001	2001
303	1	2023	2023

#### Program names:

509 - SERC Water Quality Monitoring Network

5002 - Florida STORET / WIN

95 - Harmful Algal Bloom Marine Observation Network

103 - EPA STOrage and RETrieval Data Warehouse (STORET)

69 - Fisheries-Independent Monitoring (FIM) Program

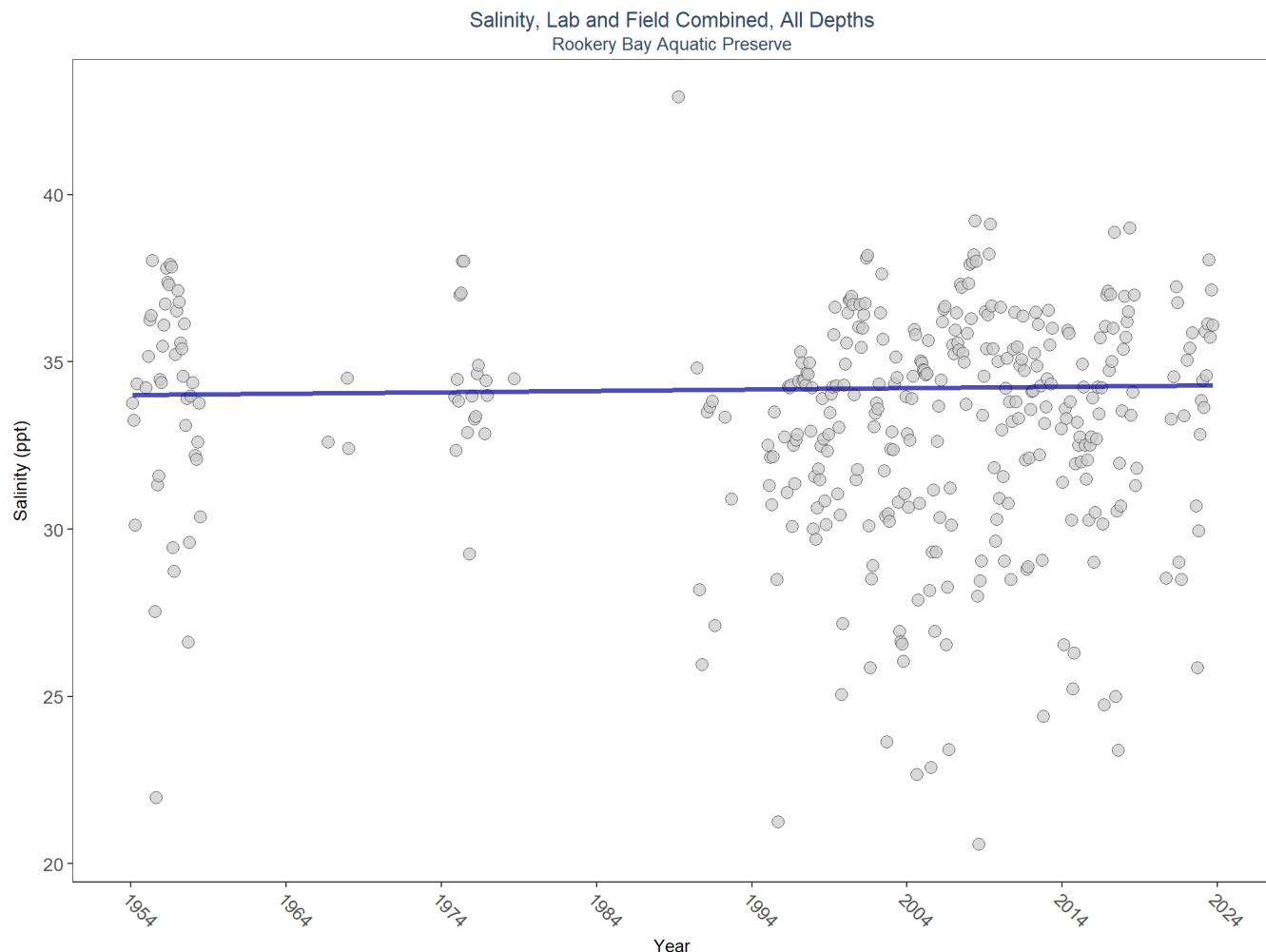
303 - River, Estuary and Coastal Observing Network

There are no qualifying Value Qualifiers for pH in Rookery Bay Aquatic Preserve

## Salinity - Discrete Water Quality

**Salinity** is a measure of the amount of salt in the water. In estuarine ecosystems, salinity is influenced by precipitation, evaporation, surface-water inputs, and exchange with coastal waters.

### Seasonal Kendall-Tau Trend Analysis

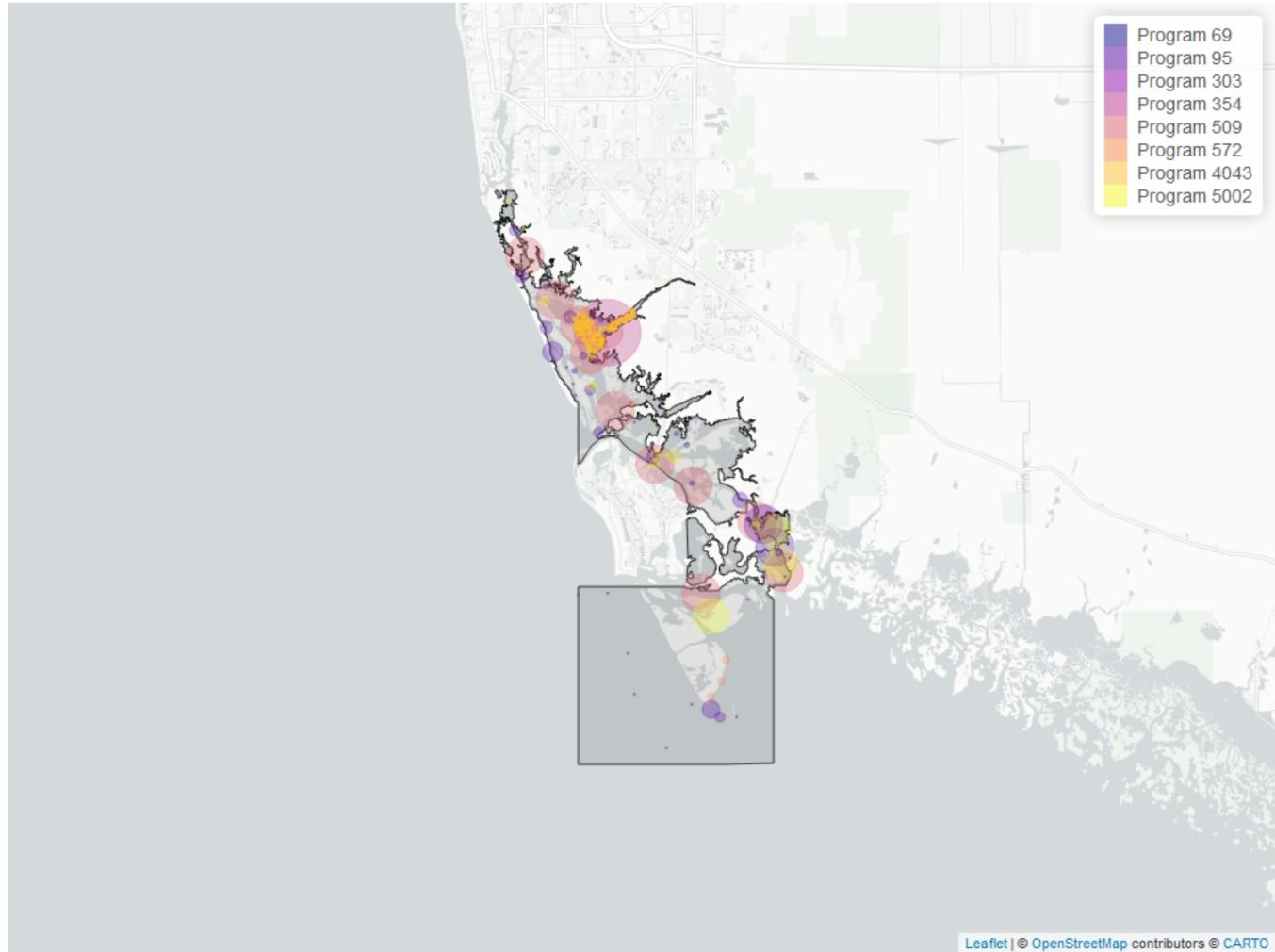


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	5237	44	34.12	TRUE	0.0202	0.5739	0.004113248	34.00826	4.0567	0.9682	0

*p < 0.00005 appear as 0 due to rounding.*

*SennIntercept is intercept value at beginning of record for monitoring location*

Map showing location of Discrete sampling sites for Salinity



The bubble size on the above plots reflects the amount of data available at each sampling site

Table 14: Programs contributing data for Salinity

ProgramID	N_Data	YearMin	YearMax
509	2439	1999	2008
95	843	1954	2018
5002	724	1989	2023
354	688	2002	2014
4043	499	2000	2009
572	31	1998	2005
69	22	2001	2001
303	1	2023	2023

#### Program names:

509 - SERC Water Quality Monitoring Network

95 - Harmful Algal Bloom Marine Observation Network

5002 - Florida STORET / WIN

354 - Rookery Bay National Estuarine Research Reserve System-Wide Monitoring Program

4043 - RBNERR Fish Assessment

572 - Rookery Bay National Estuarine Research Reserve Seagrass Monitoring

69 - Fisheries-Independent Monitoring (FIM) Program

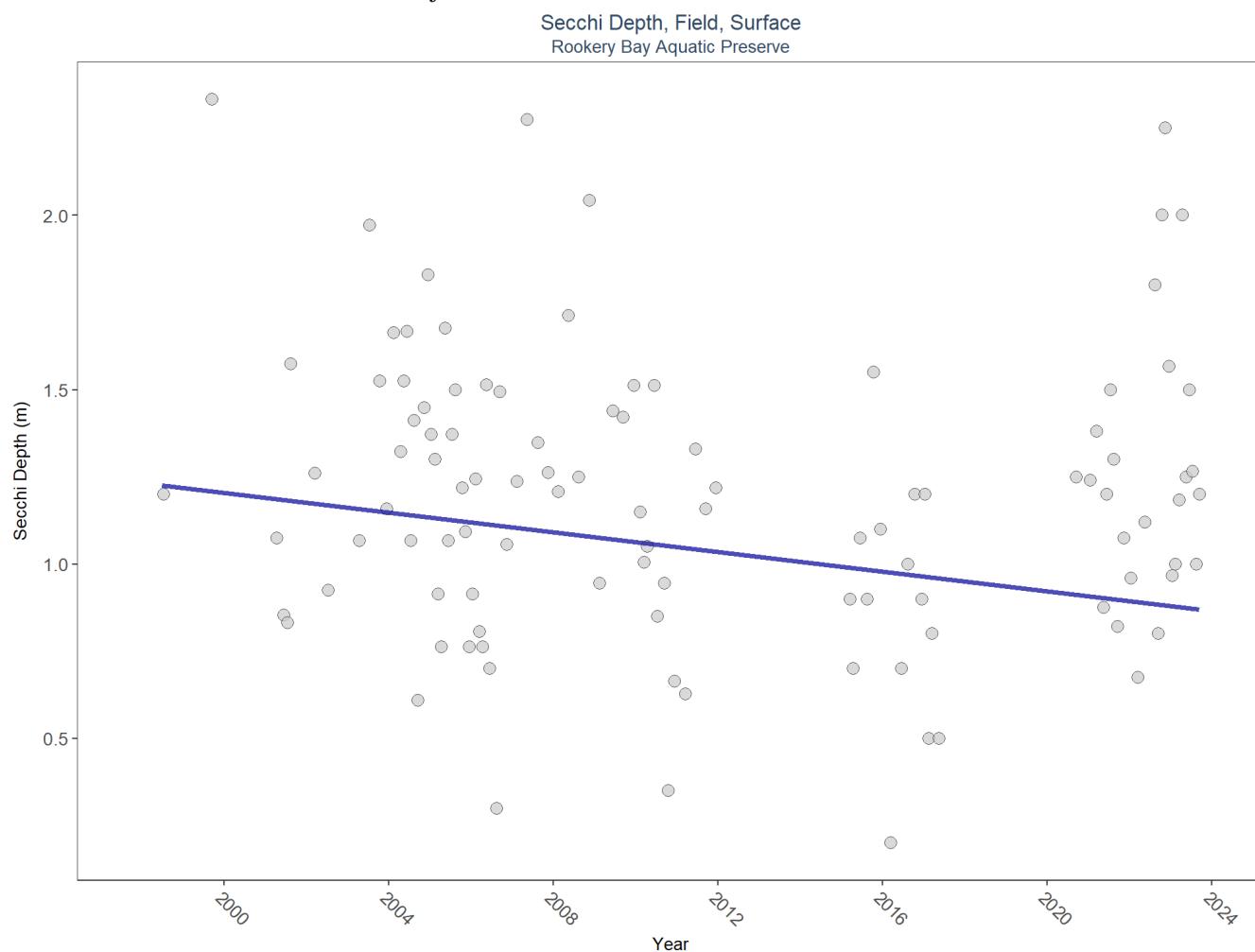
303 - River, Estuary and Coastal Observing Network

There are no qualifying Value Qualifiers for Salinity in Rookery Bay Aquatic Preserve

## Secchi Depth - Discrete Water Quality

**Secchi depth** is a measure of the transparency or clarity of the water by a device called a Secchi disk. A Secchi disk is a black and white disk that is lowered into the water on a cord. The Secchi depth is the depth at which the disk can no longer be seen. The deeper the Secchi depth, the greater the water clarity.

### Seasonal Kendall-Tau Trend Analysis

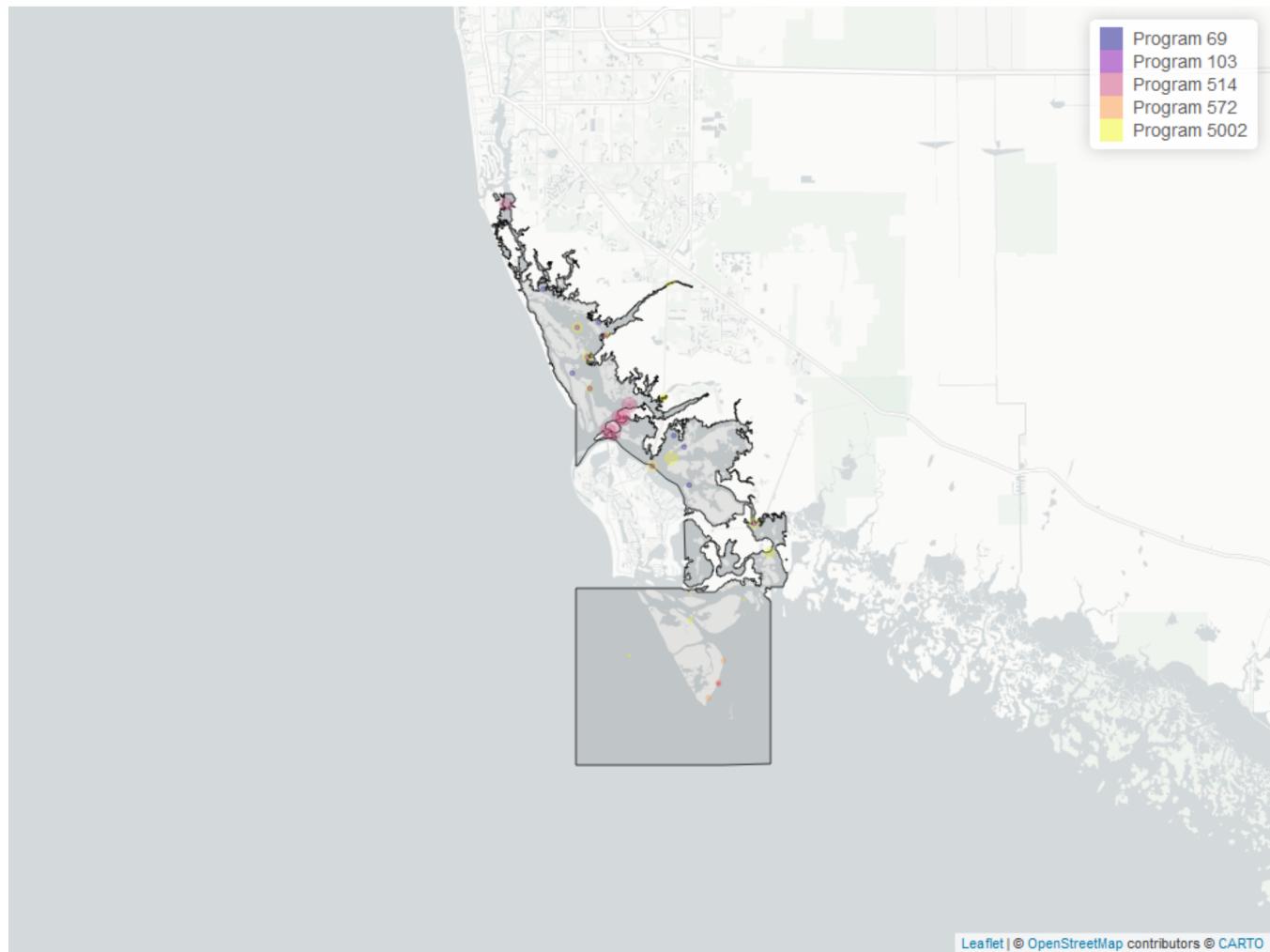


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
Surface	410	20	1.2	TRUE	-0.1415	0.0554	-0.01408301	1.232471	13.1107	0.2862	0

*p < 0.00005 appear as 0 due to rounding.*

*SennIntercept is intercept value at beginning of record for monitoring location*

Map showing location of Discrete sampling sites for Secchi Depth



The bubble size on the above plots reflects the amount of data available at each sampling site

Table 15: Programs contributing data for Secchi Depth

ProgramID	N_Data	YearMin	YearMax
514	216	2001	2011
5002	135	2006	2023
103	28	2021	2021
69	22	2001	2001
572	9	1998	2003

#### Program names:

514 - Florida LAKEWATCH Program

5002 - Florida STORET / WIN

103 - EPA STOrage and RETrieval Data Warehouse (STORET)

69 - Fisheries-Independent Monitoring (FIM) Program

## Value Qualifiers

- $N_{\_Total}$  is total amount of data for a given year
- $N_{\_}$  is the total amount of values flagged with the respective value qualifier in a given year
- $perc_{\_}$  is the percent of data flagged with the respective value qualifier as a proportion of  $N_{\_Total}$

Table 16: Value Qualifiers for Secchi Depth

Year	$N_{\_Total}$	$N_{\_S}$	$perc_{\_S}$
2015	17	5	29.4
2017	4	1	25.0
2020	4	1	25.0
2021	57	3	5.3
2022	26	2	7.7
2023	36	4	11.1

**Note:**  $^1S$  - Secchi disk visible to bottom of waterbody

## Programs containing Value Qualified data:

5002 - Florida STORET / WIN

## Total Nitrogen - Discrete Water Quality

**Nitrogen** and **Phosphorous** are key nutrients that provide nourishment essential for the growth and maintenance of aquatic plants and animals; however, excess nutrients can cause harmful algal blooms and other water quality concerns. Nutrients enter water bodies several ways, including runoff from rain events and atmospheric deposition from natural and industrial sources.

### 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.

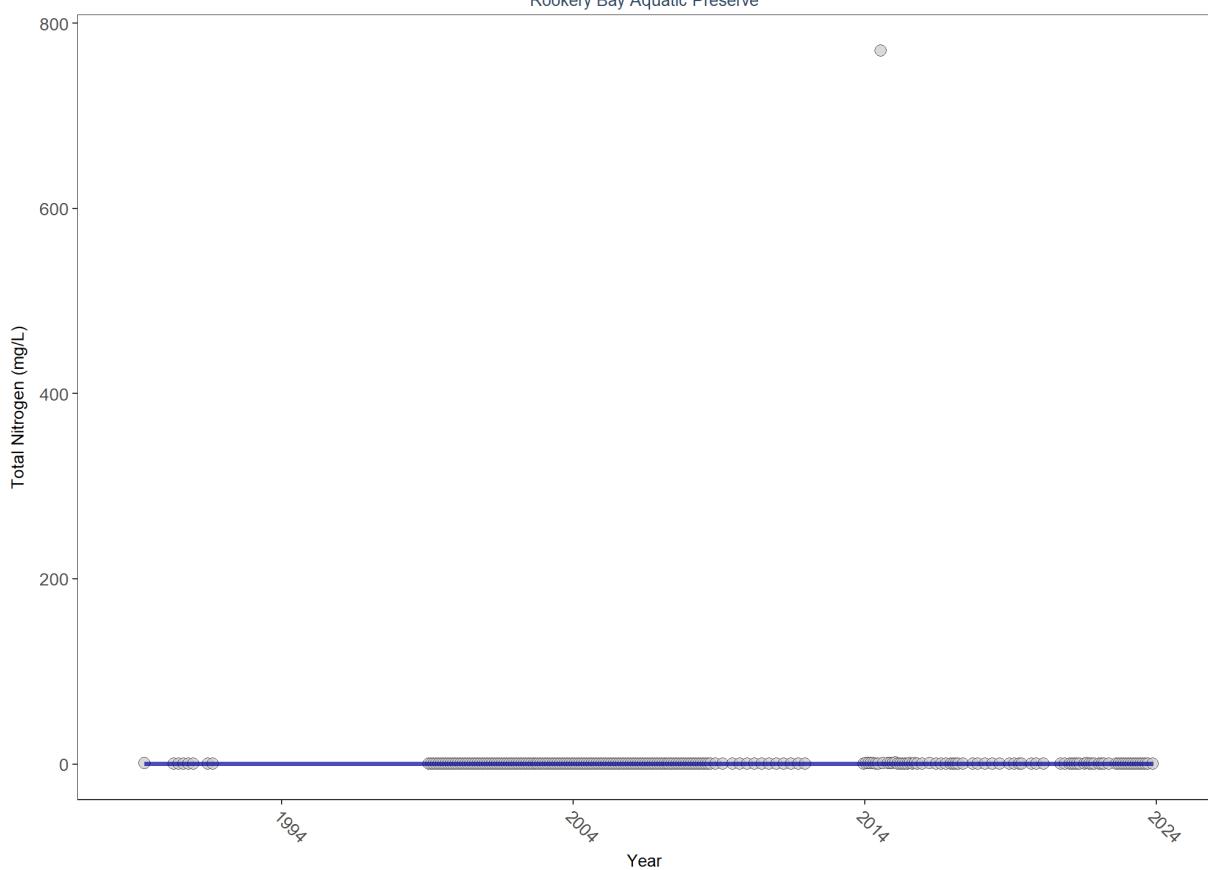
- 1)  $TN = TKN + NO_3O_2;$
- 2)  $TN = TKN + NO_3 + NO_2;$
- 3)  $TN = ORGN + NH_4 + NO_3O_2;$
- 4)  $TN = ORGN + NH_4 + NO_2 + NO_3;$
- 5)  $TN = TKN + NO_3;$
- 6)  $TN = ORGN + NH_4 + NO_3;$

### Additional Information:

- Rules for use of sample fraction:
  - FDEP report that if both “Total” and “Dissolved” are reported, only “Total” is used. If the total is not reported, they do use dissolved as a best available replacement.
  - An analysis of all SEACAR data shows that 90% of all possible TN calculations can be done using nitrogen components with the same sample fraction, rather than use nitrogen components with mixed total/dissolved sample fractions. In other words, TN can be calculated when TKN and  $NO_3O_2$  are both total sample fraction, or when both are dissolved sample fraction. This is important, because then the calculated TN value is not based on components with mixed sample fractions.
- Values inserted into data:
  - ParameterName = “Total Nitrogen”
  - SEACAR\_QAACFlagCode = “1Q”
  - SEACAR\_QAAC>Description = “SEACAR Calculated”

## Seasonal Kendall-Tau Trend Analysis

Total Nitrogen, Lab, All Depths  
Rookery Bay Aquatic Preserve

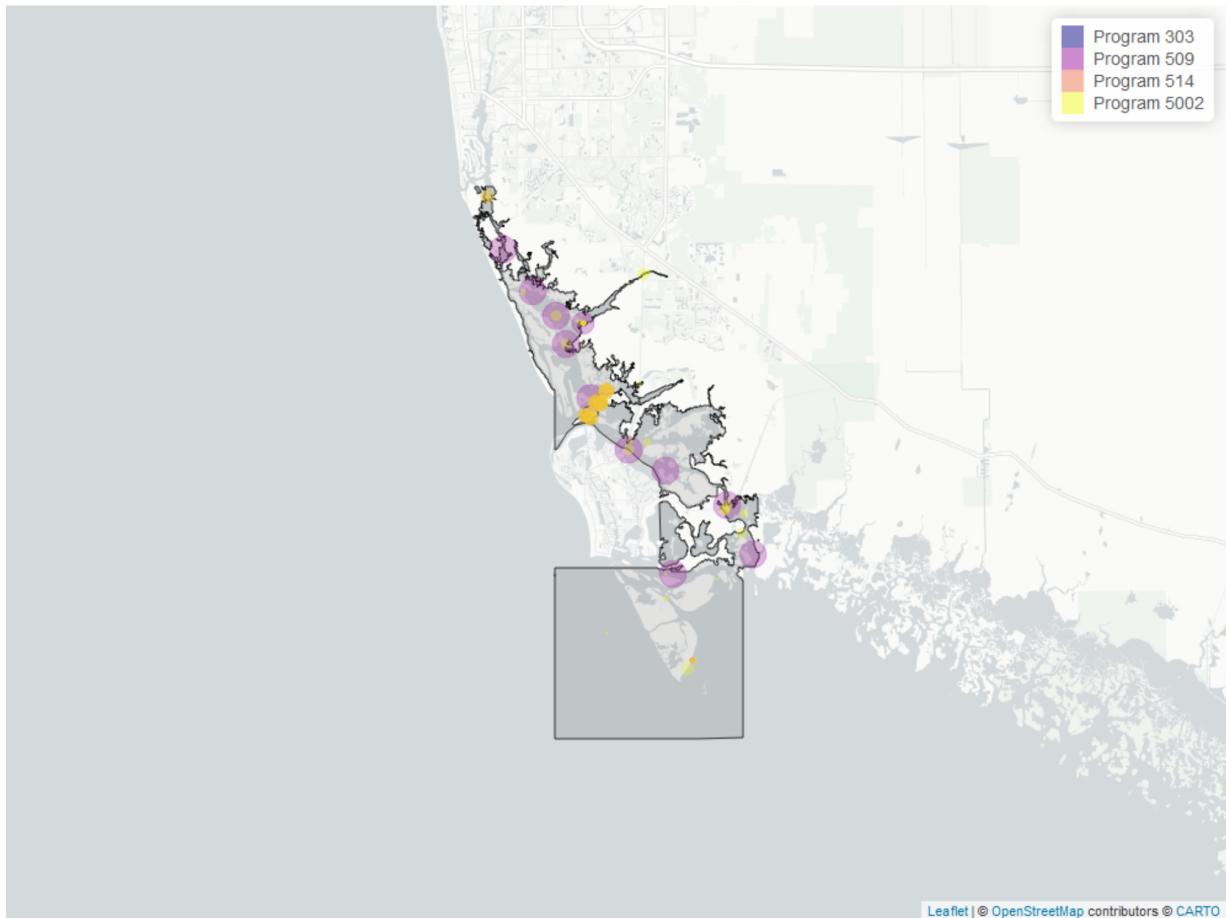


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	2541	27	0.2538	TRUE	0.1464	0.0052	0.003858736	0.200645	6.7757	0.8169	1

*p < 0.00005 appear as 0 due to rounding.*

*SennIntercept is intercept value at beginning of record for monitoring location*

Map showing location of Discrete sampling sites for Total Nitrogen



The bubble size on the above plots reflects the amount of data available at each sampling site

Table 17: Programs contributing data for Total Nitrogen

ProgramID	N_Data	YearMin	YearMax
509	1246	1999	2008
5002	747	1989	2023
514	546	2001	2011
303	2	2022	2023

**Program names:**

509 - SERC Water Quality Monitoring Network

5002 - Florida STORET / WIN

514 - Florida LAKEWATCH Program

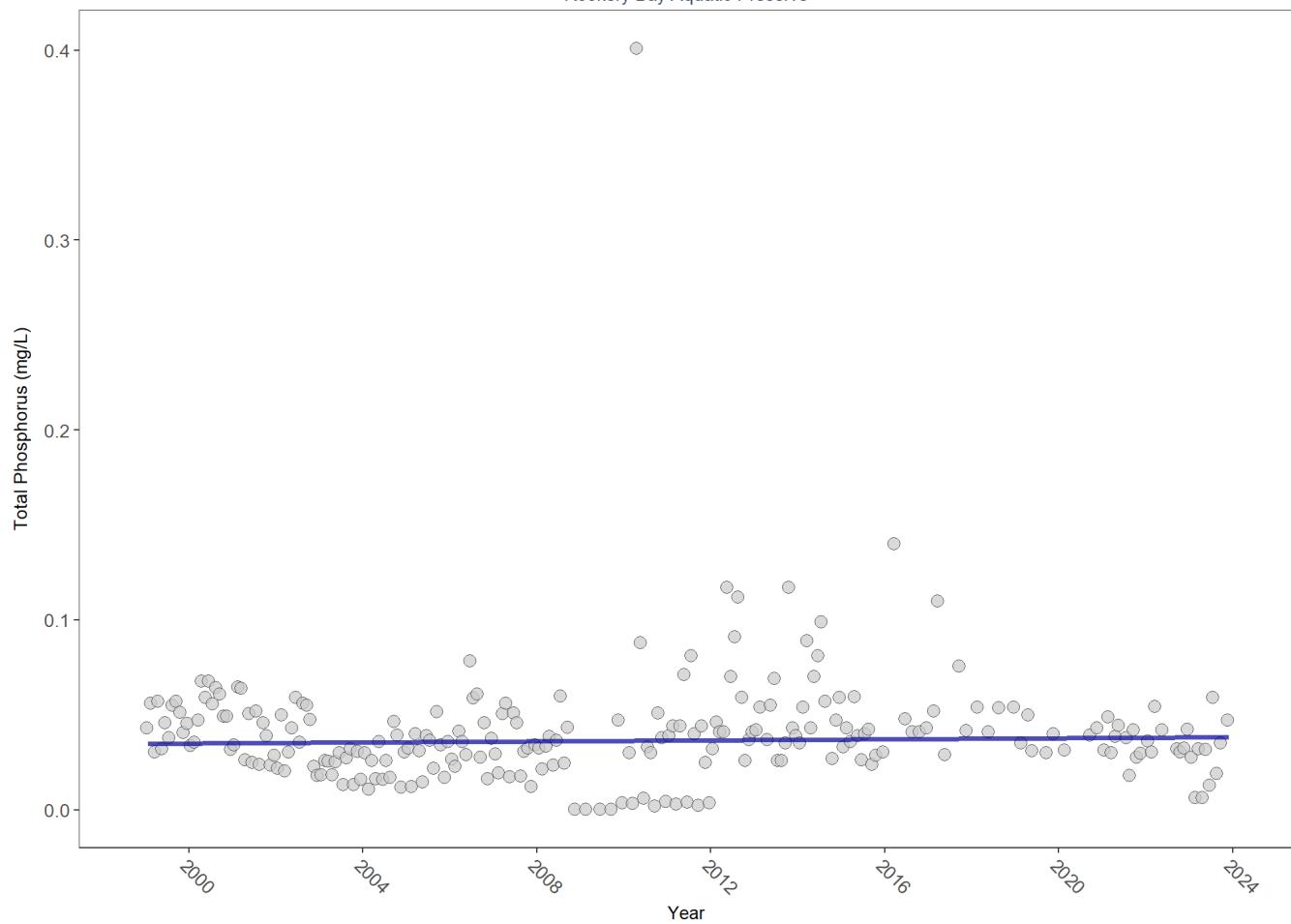
303 - River, Estuary and Coastal Observing Network

There are no qualifying Value Qualifiers for Total Nitrogen in Rookery Bay Aquatic Preserve

## Total Phosphorus - Discrete Water Quality

### Seasonal Kendall-Tau Trend Analysis

Total Phosphorus, Lab, All Depths  
Rookery Bay Aquatic Preserve



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	2036	25	0.0327	TRUE	0.0359	0.4677	0.0001306667	0.03496778	10.6984	0.4689	0

$p < 0.00005$  appear as 0 due to rounding.

SennIntercept is intercept value at beginning of record for monitoring location

Map showing location of Discrete sampling sites for Total Phosphorus

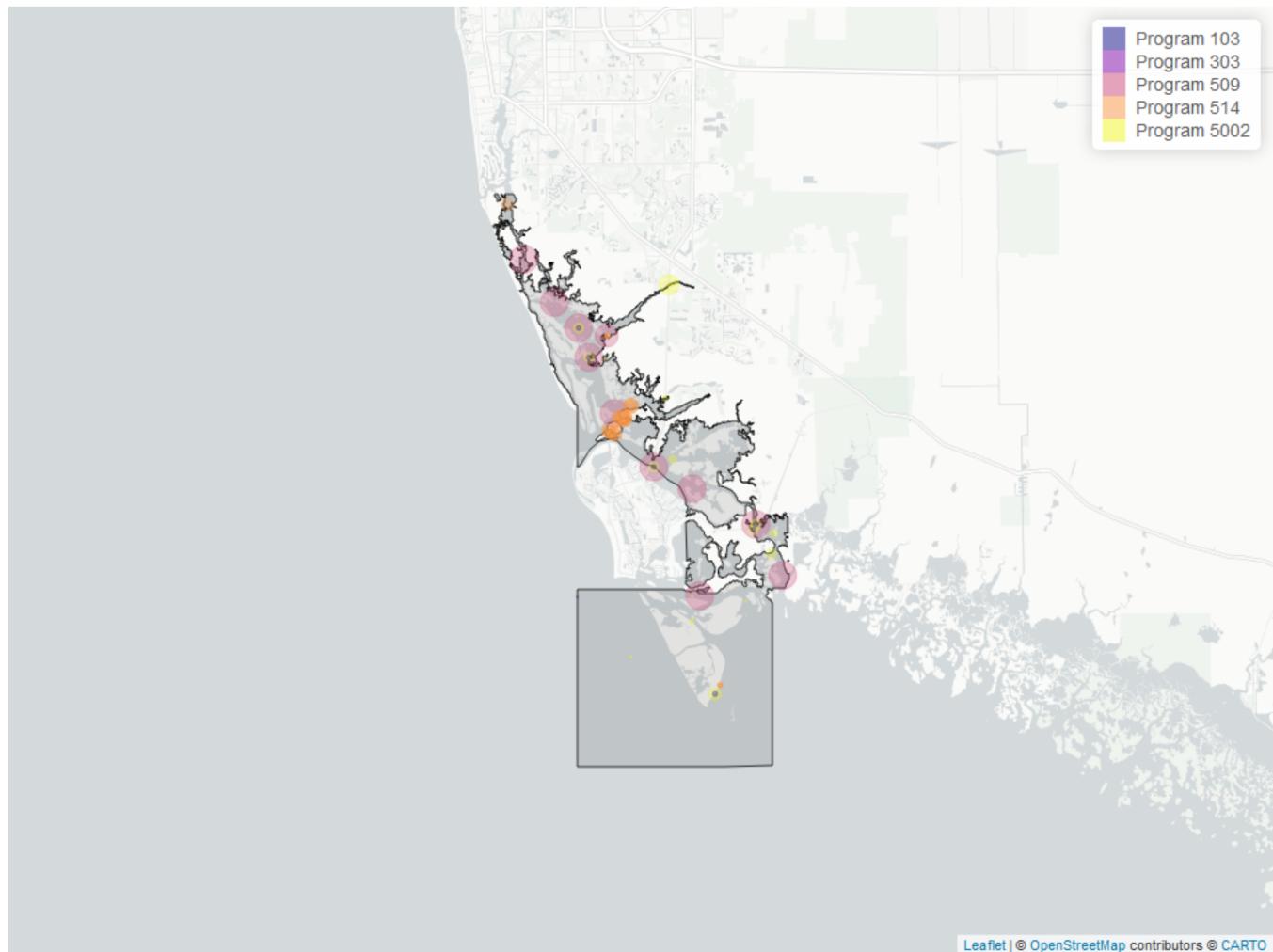


Table 18: Programs contributing data for Total Phosphorus

ProgramID	N_Data	YearMin	YearMax
509	1236	1999	2008
514	542	2001	2011
5002	227	2002	2023
103	32	2021	2021
303	2	2022	2023

#### Program names:

509 - SERC Water Quality Monitoring Network

514 - Florida LAKEWATCH Program

5002 - Florida STORET / WIN

103 - EPA STOrage and RETrieval Data Warehouse (STORET)

### Value Qualifiers

- $N_{\text{Total}}$  is total amount of data for a given year
- $N_{\text{I}}$  is the total amount of values flagged with the respective value qualifier in a given year
- $\text{perc}_{\text{I}}$  is the percent of data flagged with the respective value qualifier as a proportion of  $N_{\text{Total}}$

Table 19: Value Qualifiers for Total Phosphorus

Year	$N_{\text{Total}}$	$N_{\text{I}}$	$\text{perc}_{\text{I}}$	$N_{\text{U}}$	$\text{perc}_{\text{U}}$
2006	190	5	2.6		
2022	30	1	3.3		
2023	35	5	14.3	3	8.6

**Note:** <sup>1</sup>**I** - Reported value is greater than or equal to lab method detection limit, but less than quantitation limit <sup>2</sup>**U** - Compound was analyzed for but not detected

### Programs containing Value Qualified data:

5002 - Florida STORET / WIN

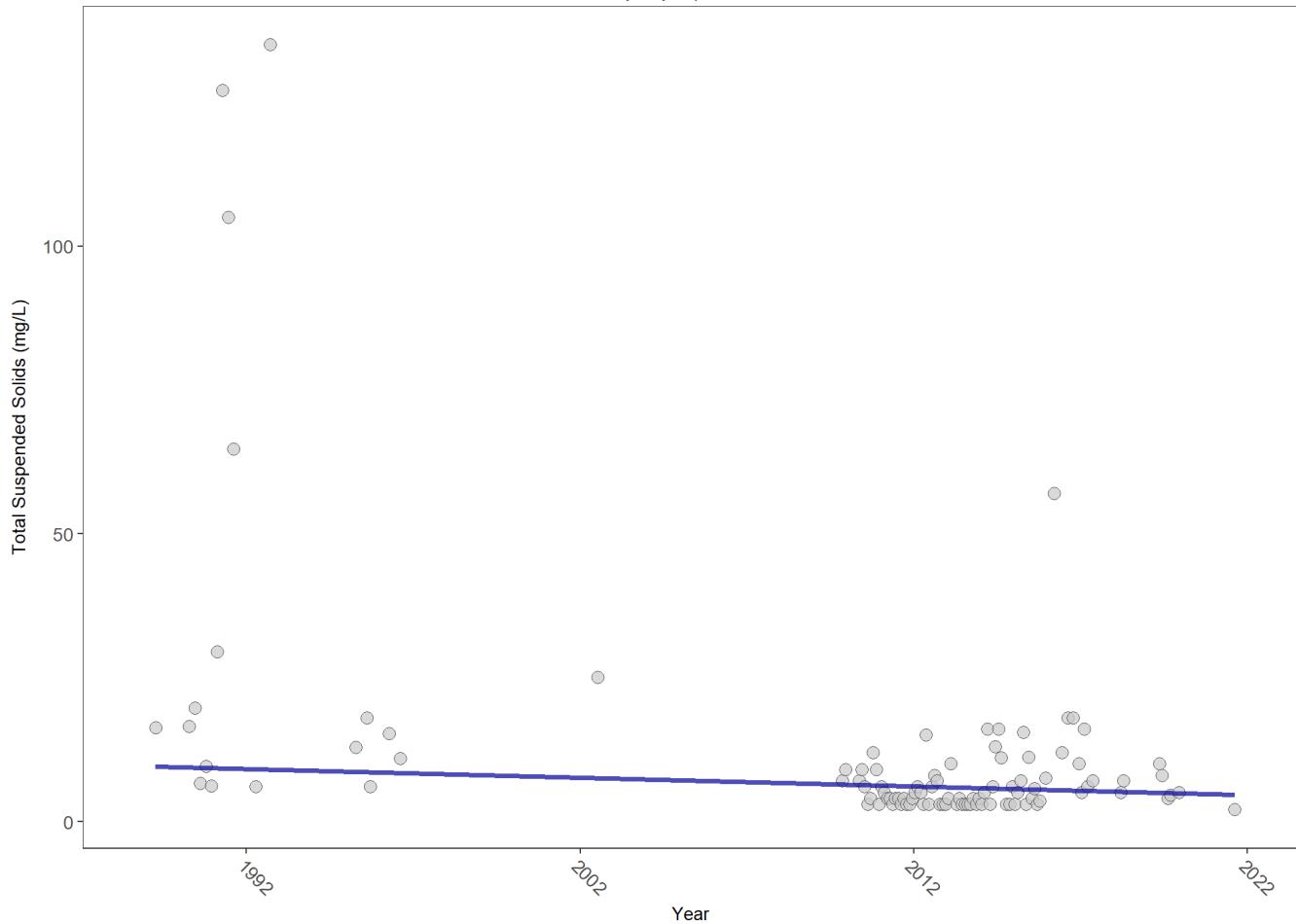
303 - River, Estuary and Coastal Observing Network

## Total Suspended Solids - Discrete Water Quality

**Total Suspended Solids (TSS)** are solid particles suspended in water that exceed 2 microns in size and can be trapped by a filter.

### Seasonal Kendall-Tau Trend Analysis

Total Suspended Solids, Lab and Field Combined, All Depths  
Rookery Bay Aquatic Preserve

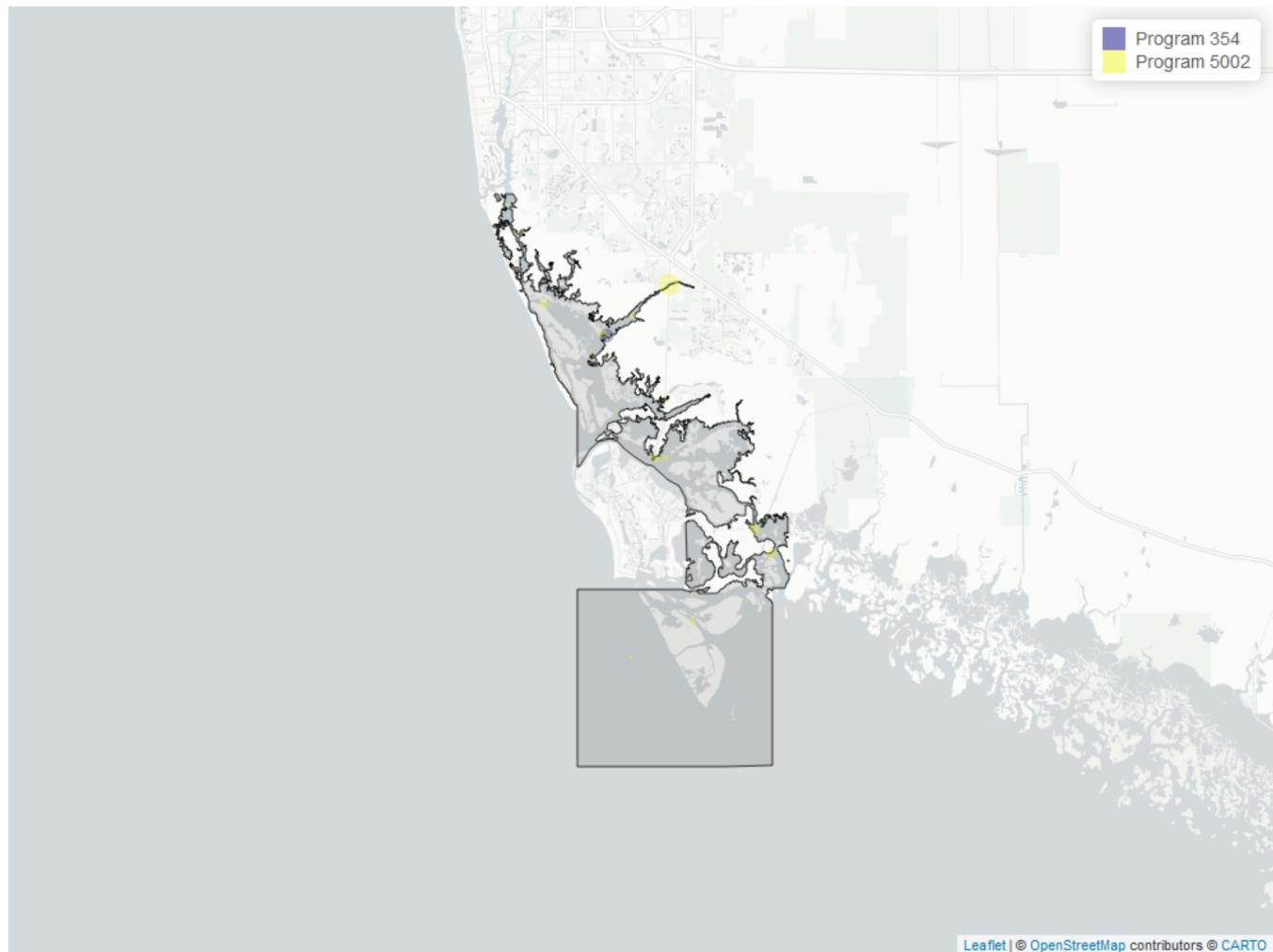


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	159	19	7	TRUE	-0.1771	0.0225	-0.15	9.550982	10.0916	0.5222	-1

*p < 0.00005 appear as 0 due to rounding.*

*SennIntercept is intercept value at beginning of record for monitoring location*

Map showing location of Discrete sampling sites for Total Suspended Solids



The bubble size on the above plots reflects the amount of data available at each sampling site

Table 20: Programs contributing data for Total Suspended Solids

ProgramID	N_Data	YearMin	YearMax
5002	151	1989	2021
354	25	2016	2019

#### Program names:

5002 - Florida STORET / WIN

354 - Rookery Bay National Estuarine Research Reserve System-Wide Monitoring Program

#### Value Qualifiers

- $N_{Total}$  is total amount of data for a given year
- $N_{\text{Qualifier}}$  is the total amount of values flagged with the respective value qualifier in a given year
- $\text{perc}_{\text{Qualifier}}$  is the percent of data flagged with the respective value qualifier as a proportion of  $N_{Total}$

Table 21: Value Qualifiers for Total Suspended Solids

<i>Year</i>	<i>N_Total</i>	<i>N_I</i>	<i>perc_I</i>	<i>N_U</i>	<i>perc_U</i>
2009	2	2	100.0		
2010	8	5	62.5	2	25.0
2011	12	9	75.0	3	25.0
2012	12	7	58.3	4	33.3
2013	11	5	45.5	6	54.5
2014	11	5	45.5	3	27.3
2015	28	13	46.4	6	21.4
2017	8	3	37.5		
2021	1			1	100.0

**Note:** <sup>1</sup>**I** - Reported value is greater than or equal to lab method detection limit, but less than quantitation limit <sup>2</sup>**U** - Compound was analyzed for but not detected

#### **Programs containing Value Qualified data:**

5002 - Florida STORET / WIN

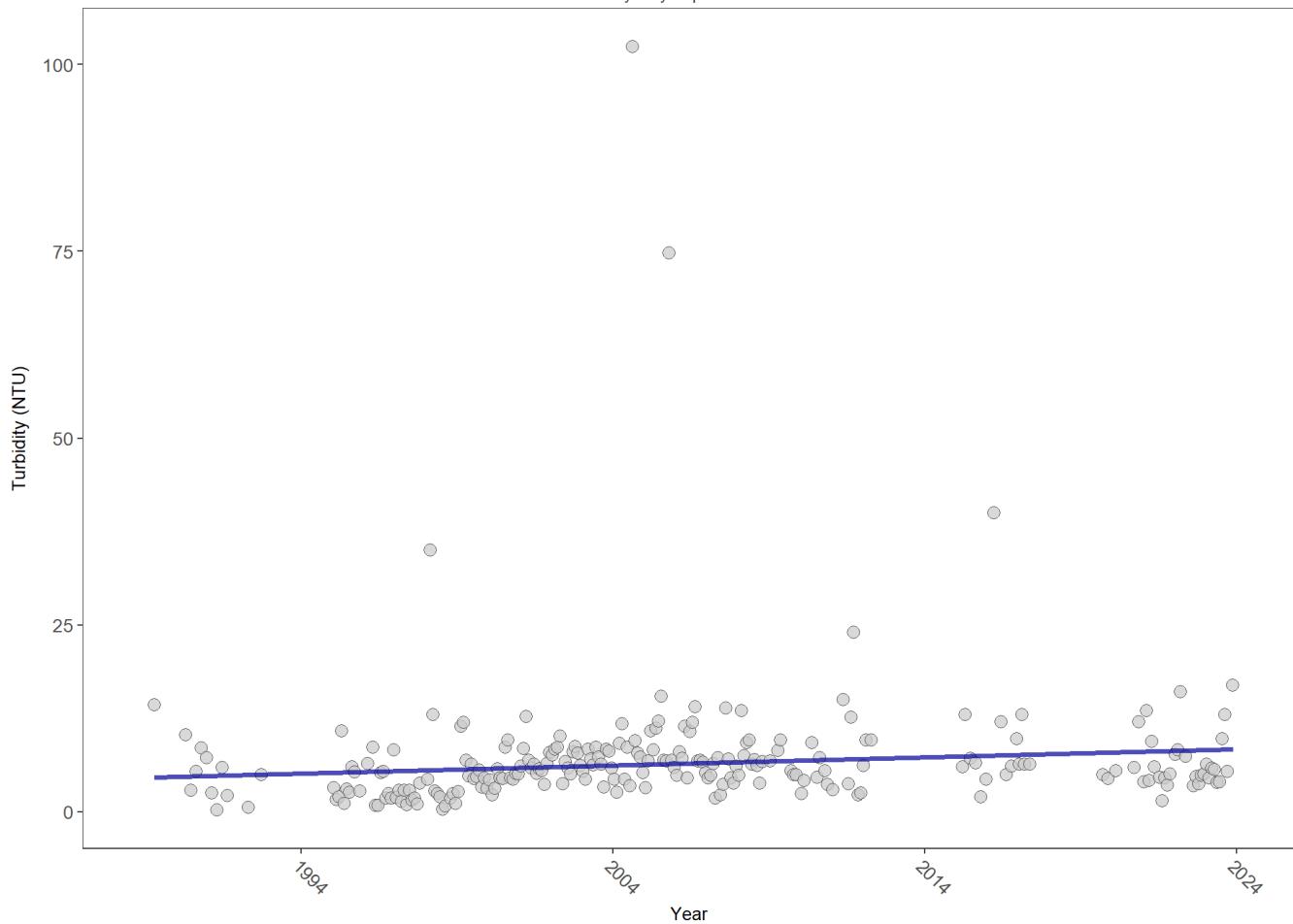
354 - Rookery Bay National Estuarine Research Reserve System-Wide Monitoring Program

#### **Turbidity - Discrete Water Quality**

**Turbidity** results from suspended solids in the water, including silts, clays, tannins, industrial wastes, sewage and plankton, which are all factors that contribute to how clouded or murky a water column is. Turbidity is caused by soil erosion, excess nutrients, pollutants, and physical forces such as winds, currents and bottom feeders.

#### **Seasonal Kendall-Tau Trend Analysis**

Turbidity, Lab and Field Combined, All Depths  
Rookery Bay Aquatic Preserve



*p < 0.00005 appear as 0 due to rounding.*

*SennIntercept is intercept value at beginning of record for monitoring location*

Map showing location of Discrete sampling sites for Turbidity

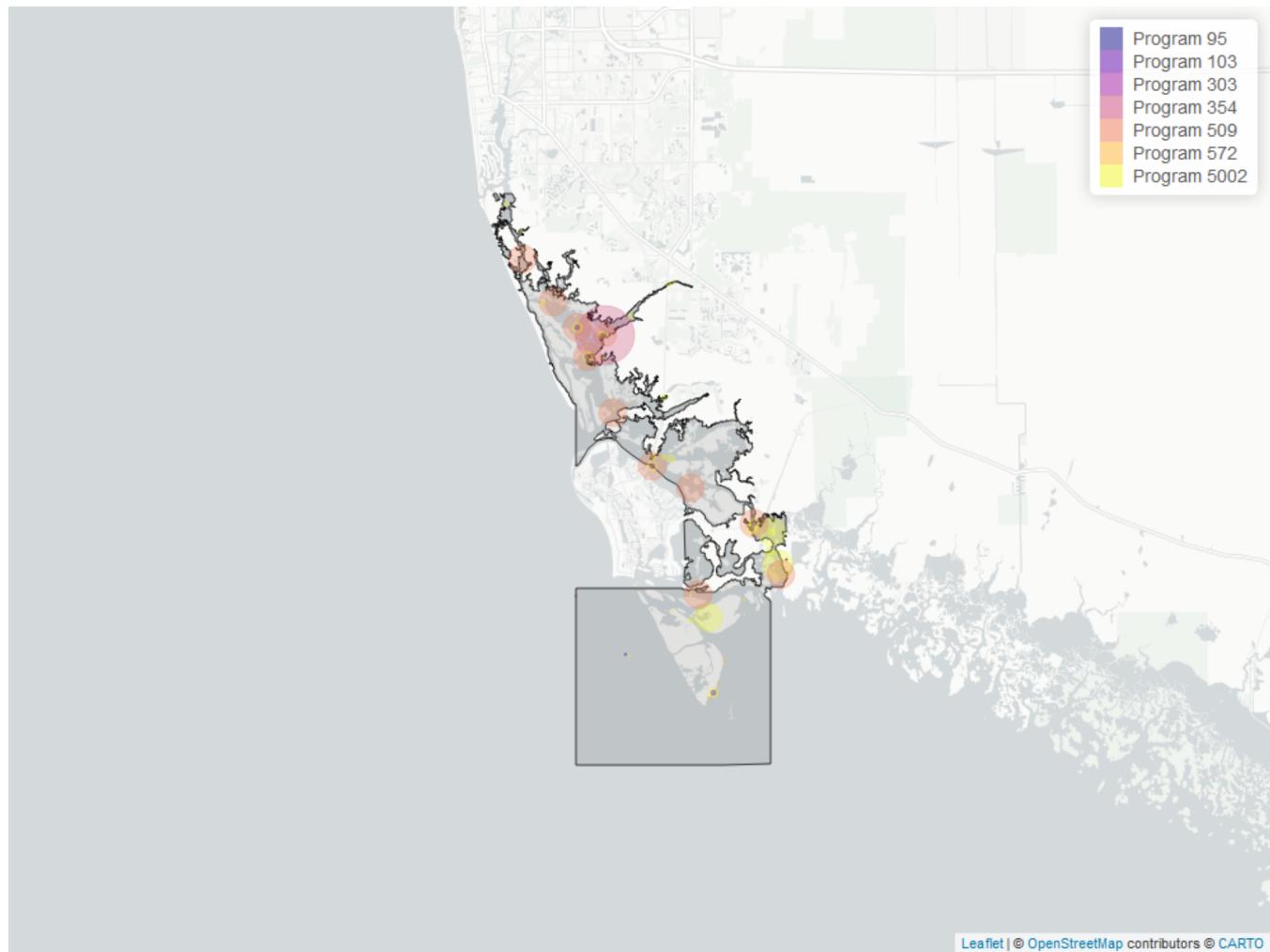


Table 22: Programs contributing data for Turbidity

ProgramID	N_Data	YearMin	YearMax
509	1236	1999	2008
5002	589	1989	2023
354	527	2002	2006
103	32	2021	2021
572	4	2000	2003
95	3	2003	2011
303	1	2023	2023

**Program names:**

509 - SERC Water Quality Monitoring Network

5002 - Florida STORET / WIN

354 - Rookery Bay National Estuarine Research Reserve System-Wide Monitoring Program

103 - EPA STOrage and RETrieval Data Warehouse (STORET)

572 - Rookery Bay National Estuarine Research Reserve Seagrass Monitoring

95 - Harmful Algal Bloom Marine Observation Network

303 - River, Estuary and Coastal Observing Network

### Value Qualifiers

- $N_{Total}$  is total amount of data for a given year
- $N_Q$  is the total amount of values flagged with the respective value qualifier in a given year
- $perc_Q$  is the percent of data flagged with the respective value qualifier as a proportion of  $N_{Total}$

Table 23: Value Qualifiers for Turbidity

Year	$N_{Total}$	$N_Q$	$perc_Q$
2011	20	1	5.0
2017	4	1	25.0
2021	65	2	3.1
2022	29	2	6.9
2023	35	4	11.4

**Note:** <sup>1</sup>**Q** - Sample held beyond the accepted holding time

### Programs containing Value Qualified data:

354 - Rookery Bay National Estuarine Research Reserve System-Wide Monitoring Program

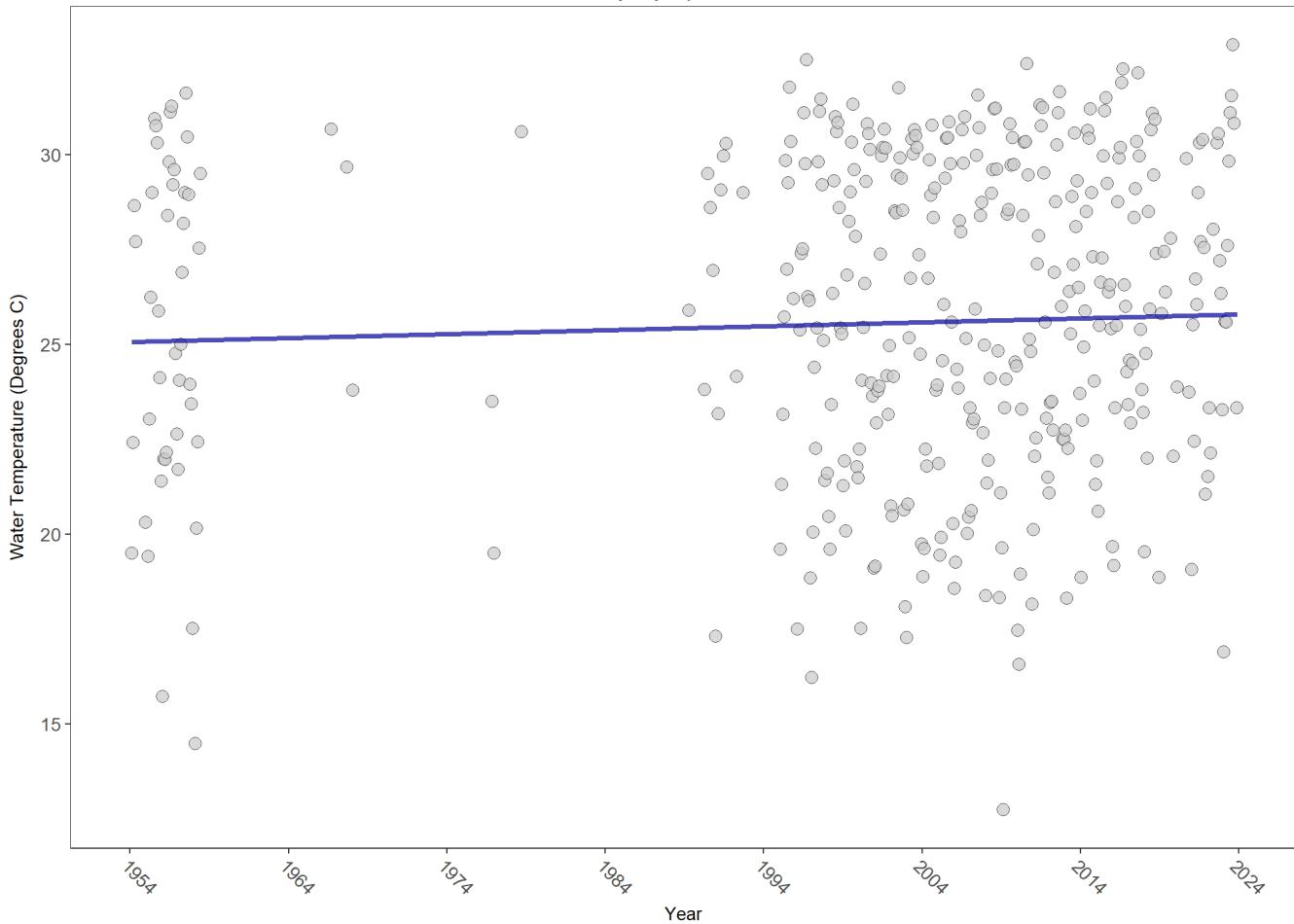
5002 - Florida STORET / WIN

## Water Temperature - Discrete Water Quality

**Temperature** determines the capacity of water to hold oxygen. Cooler water can hold more dissolved oxygen because water molecules are more tightly packed, making it harder for oxygen to escape. Additionally, as water temperature increases, fish and other aquatic organisms become more active and consume oxygen at a faster rate.

### Seasonal Kendall-Tau Trend Analysis

Water Temperature, Field, All Depths  
Rookery Bay Aquatic Preserve

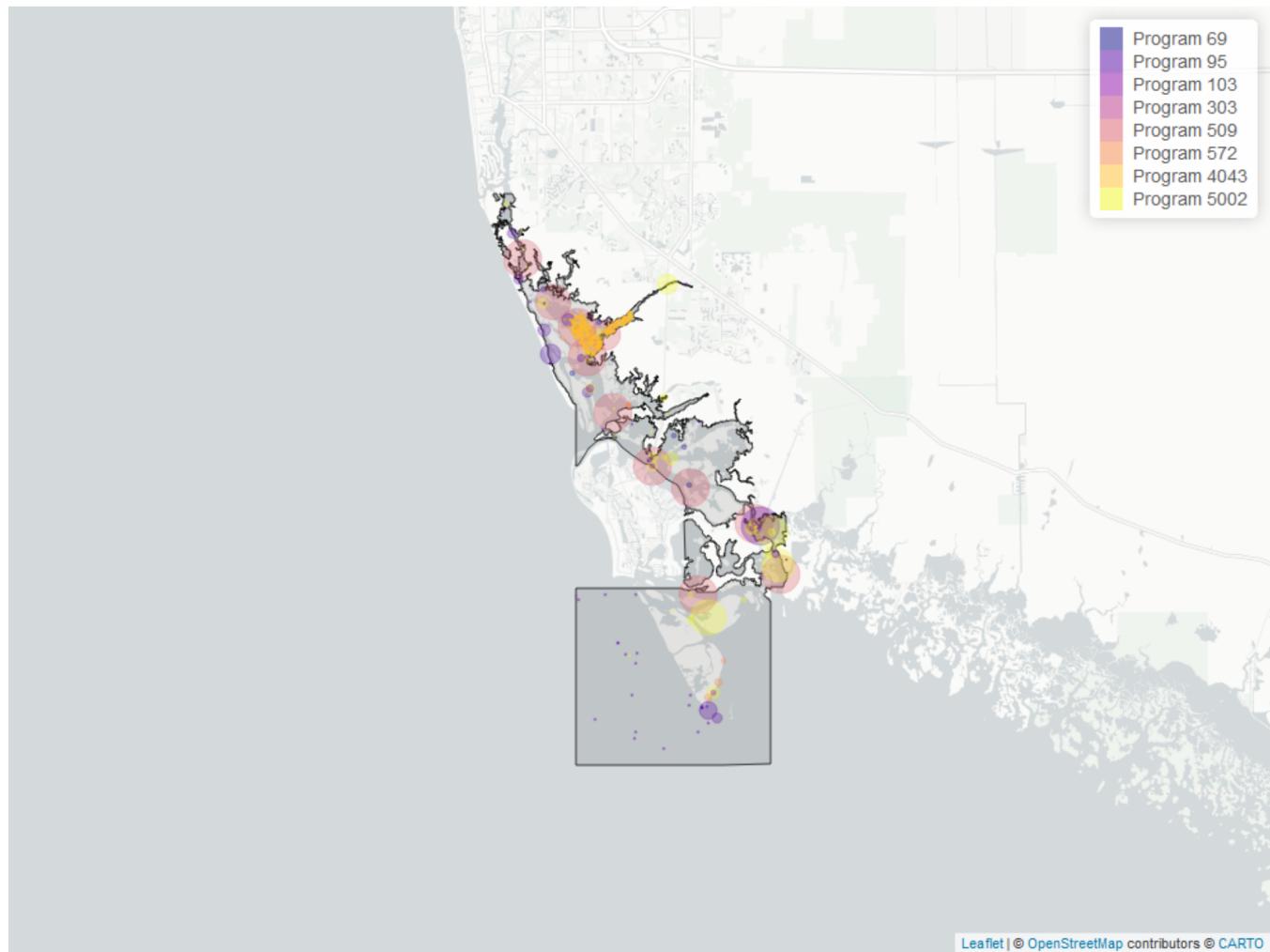


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	4503	43	26.28	TRUE	0.0819	0.0202	0.01055456	25.05653	12.425	0.3326	1

*p < 0.00005 appear as 0 due to rounding.*

*SennIntercept is intercept value at beginning of record for monitoring location*

Map showing location of Discrete sampling sites for Water Temperature



The bubble size on the above plots reflects the amount of data available at each sampling site

Table 24: Programs contributing data for Water Temperature

ProgramID	N_Data	YearMin	YearMax
509	2443	1999	2008
5002	908	1989	2023
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:**

509 - SERC Water Quality Monitoring Network

*5002* - Florida STORET / WIN

*95* - Harmful Algal Bloom Marine Observation Network

*4043* - RBNERR Fish Assessment

*103* - EPA STOrage and RETrieval Data Warehouse (STORET)

*572* - Rookery Bay National Estuarine Research Reserve Seagrass Monitoring

*69* - Fisheries-Independent Monitoring (FIM) Program

*303* - River, Estuary and Coastal Observing Network

There are no qualifying Value Qualifiers for Water Temperature in Rookery Bay Aquatic Preserve

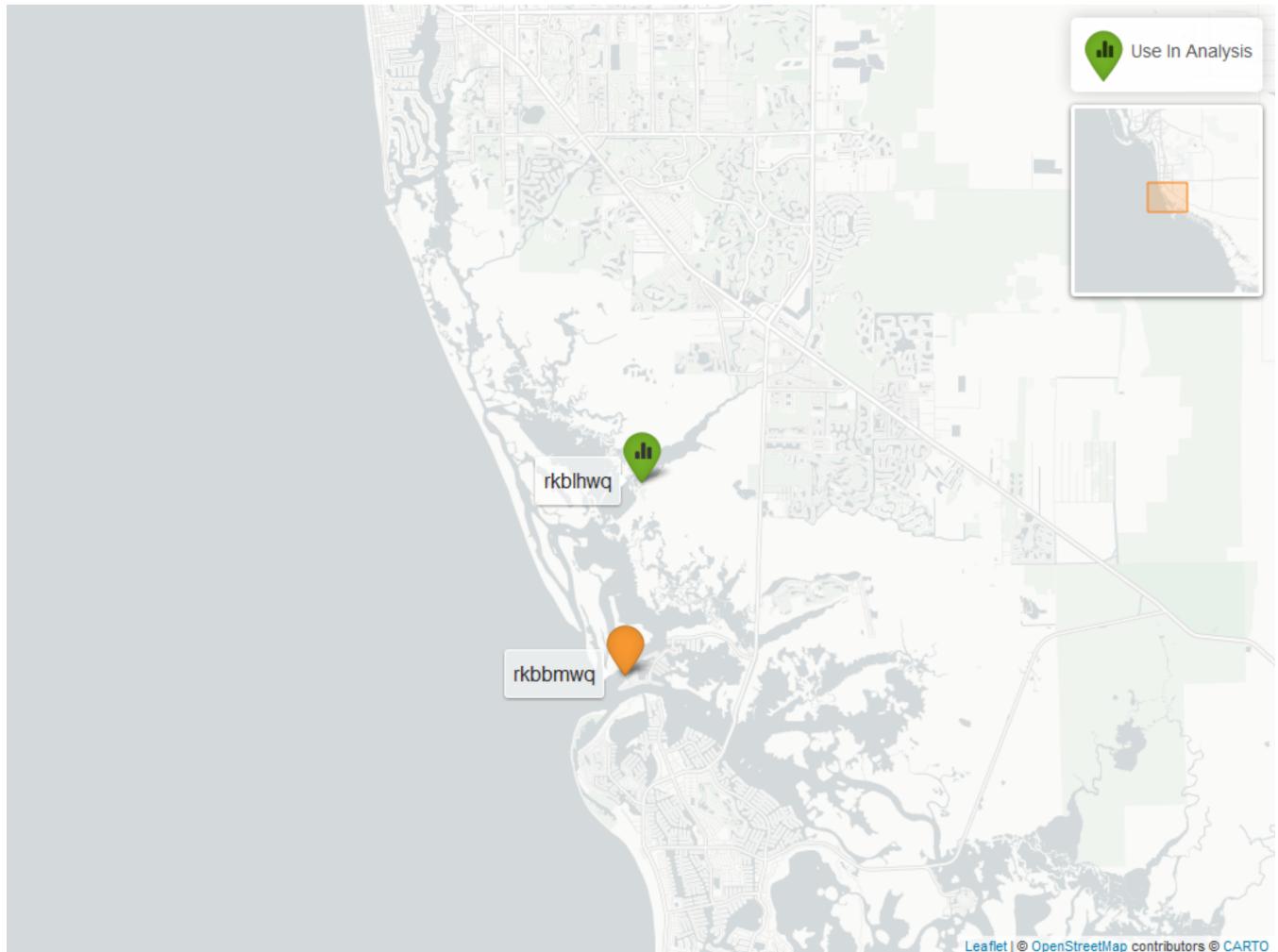
## Water Quality - Continuous

The following files were used in the continuous analysis:

- *Combined\_WQ\_WC\_NUT\_cont\_Dissolved\_Oxygen\_SW-2024-Feb-23.txt*
- *Combined\_WQ\_WC\_NUT\_cont\_Dissolved\_Oxygen\_Saturation\_SW-2024-Feb-22.txt*
- *Combined\_WQ\_WC\_NUT\_cont\_pH\_SW-2024-Feb-23.txt*
- *Combined\_WQ\_WC\_NUT\_cont\_Salinity\_SW-2024-Feb-23.txt*
- *Combined\_WQ\_WC\_NUT\_cont\_Turbidity\_SW-2024-Feb-22.txt*
- *Combined\_WQ\_WC\_NUT\_cont\_Water\_Temperature\_SW-2024-Feb-23.txt*

Table 25: 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>
rkbmhwq	2	FALSE	DO , DOS , pH , Sal , Turb , TempW
rkbhwq	24	TRUE	DO , DOS , pH , Sal , Turb , TempW



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 - Continuous Water Quality

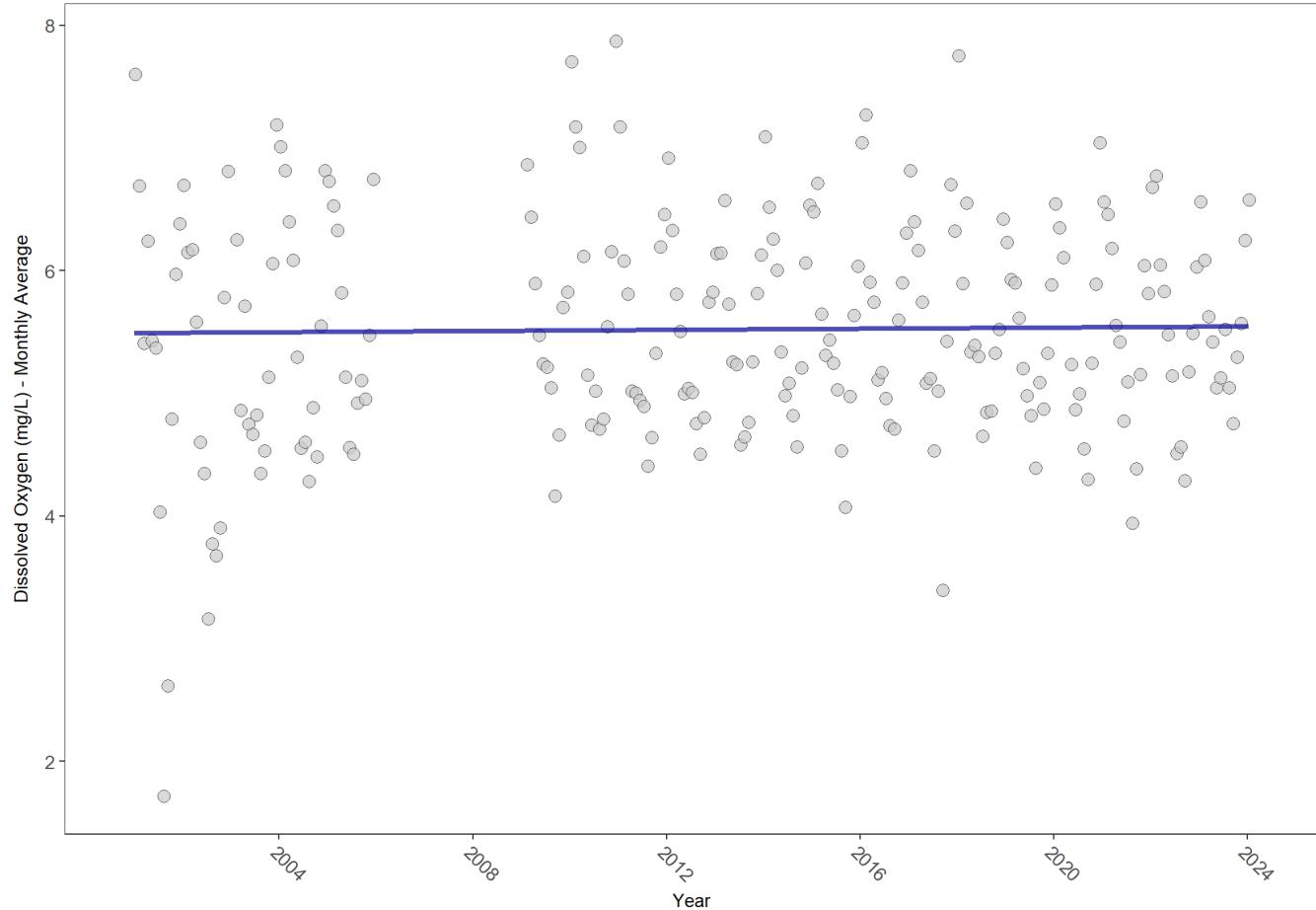
rkbhwq

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

Rookery Bay Aquatic Preserve

rkbhwq

Dissolved Oxygen



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
bottom	549144	21	5.5	TRUE	0.0191	0.6560	0.002343171	5.491005	20.7278	0.0363	0

*p < 0.00005 appear as 0 due to rounding.*

*SennIntercept is intercept value at beginning of record for monitoring location*

## Dissolved Oxygen Saturation - Continuous Water Quality

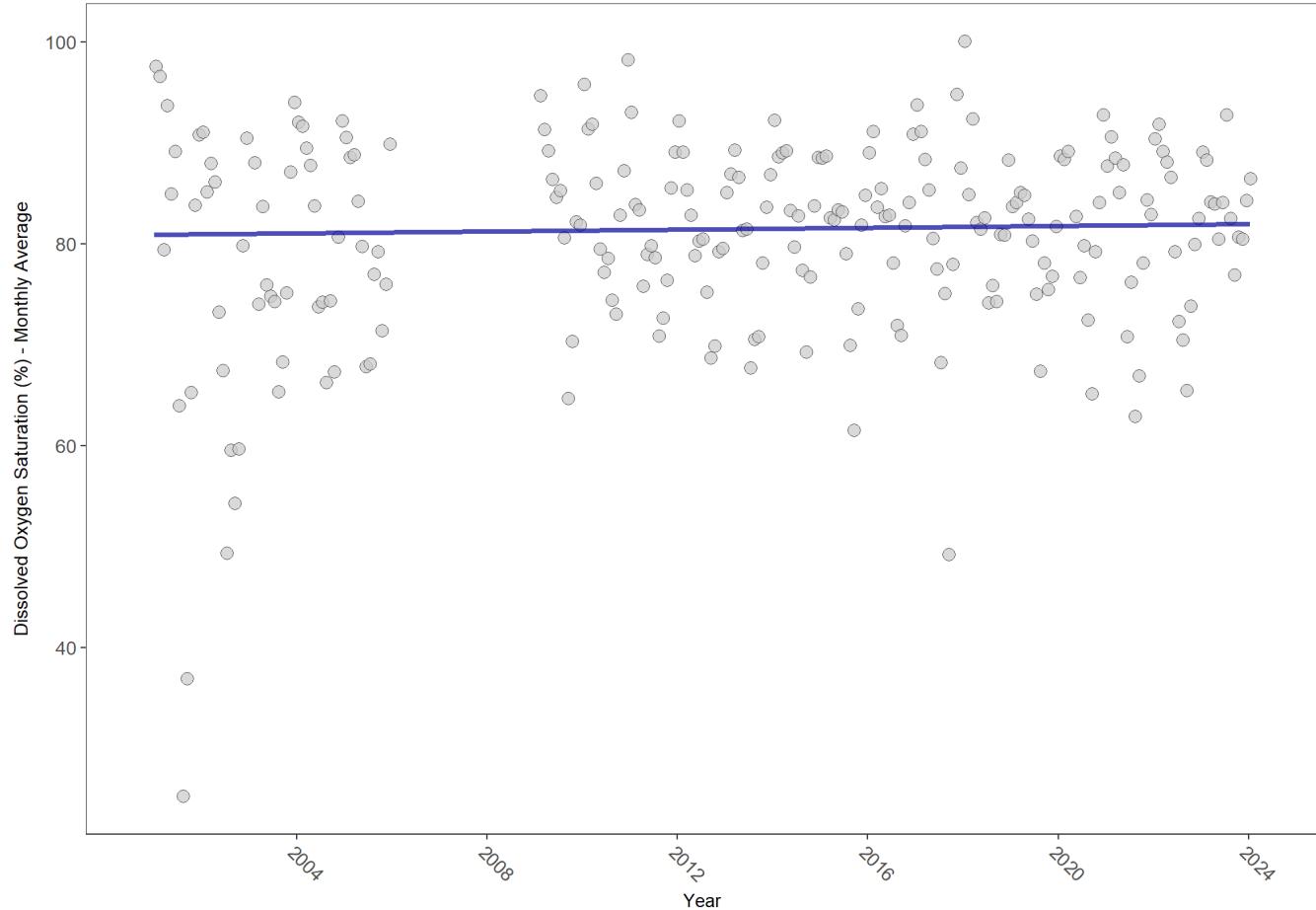
rkbhwq

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

Rookery Bay Aquatic Preserve

rkbhwq

Dissolved Oxygen Saturation



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
bottom	561462	21	81.9	TRUE	0.0411	0.3580	0.04493568	80.92275	23.55	0.0148	0

*p < 0.00005 appear as 0 due to rounding.*

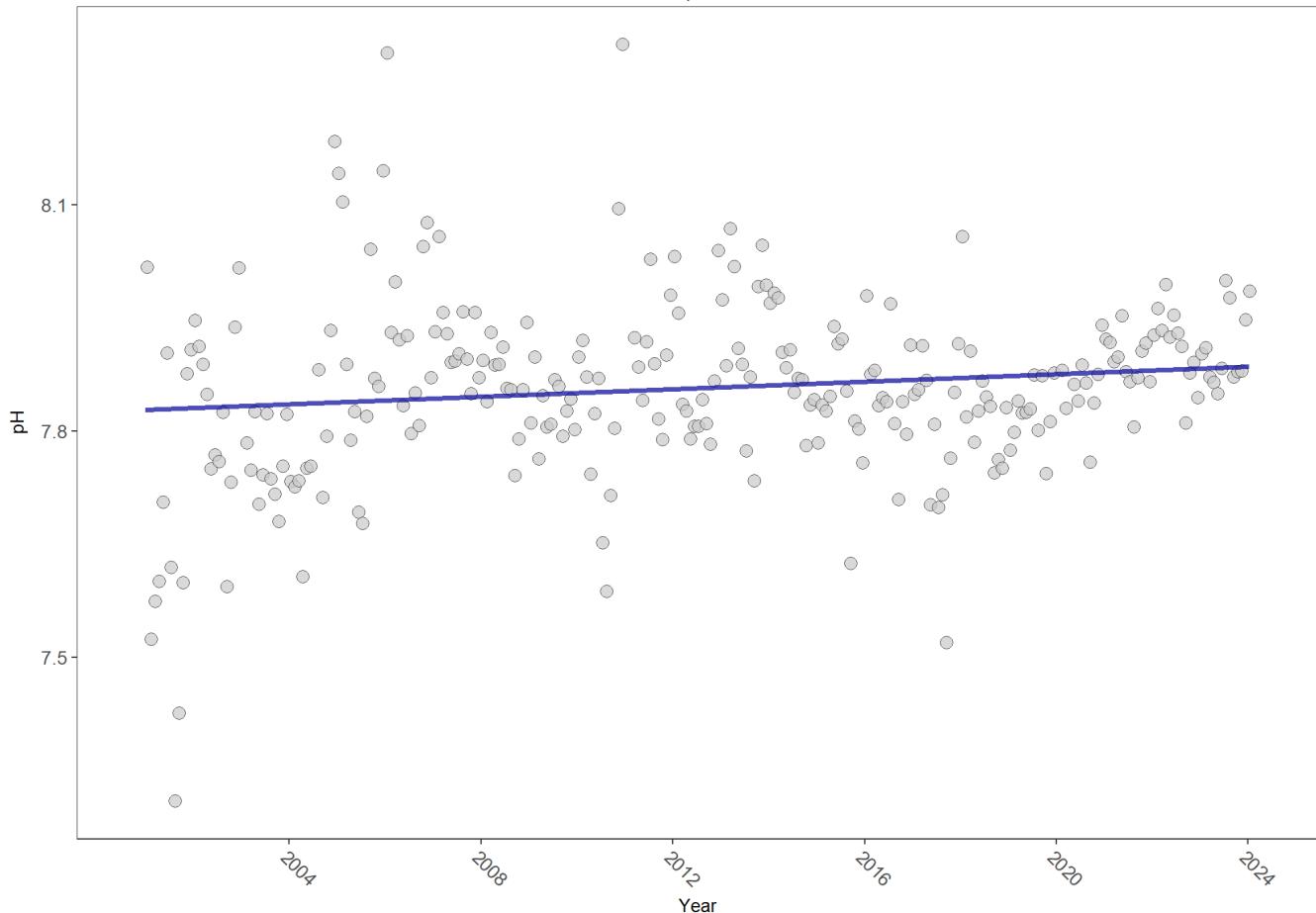
*SennIntercept is intercept value at beginning of record for monitoring location*

## pH - Continuous Water Quality

rkbhwq

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

Rookery Bay Aquatic Preserve  
rkbhwq  
pH



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
bottom	608282	24	7.9	TRUE	0.1249	0.0042	0.002492506	7.827925	17.0101	0.1076	1

*p < 0.00005 appear as 0 due to rounding.*

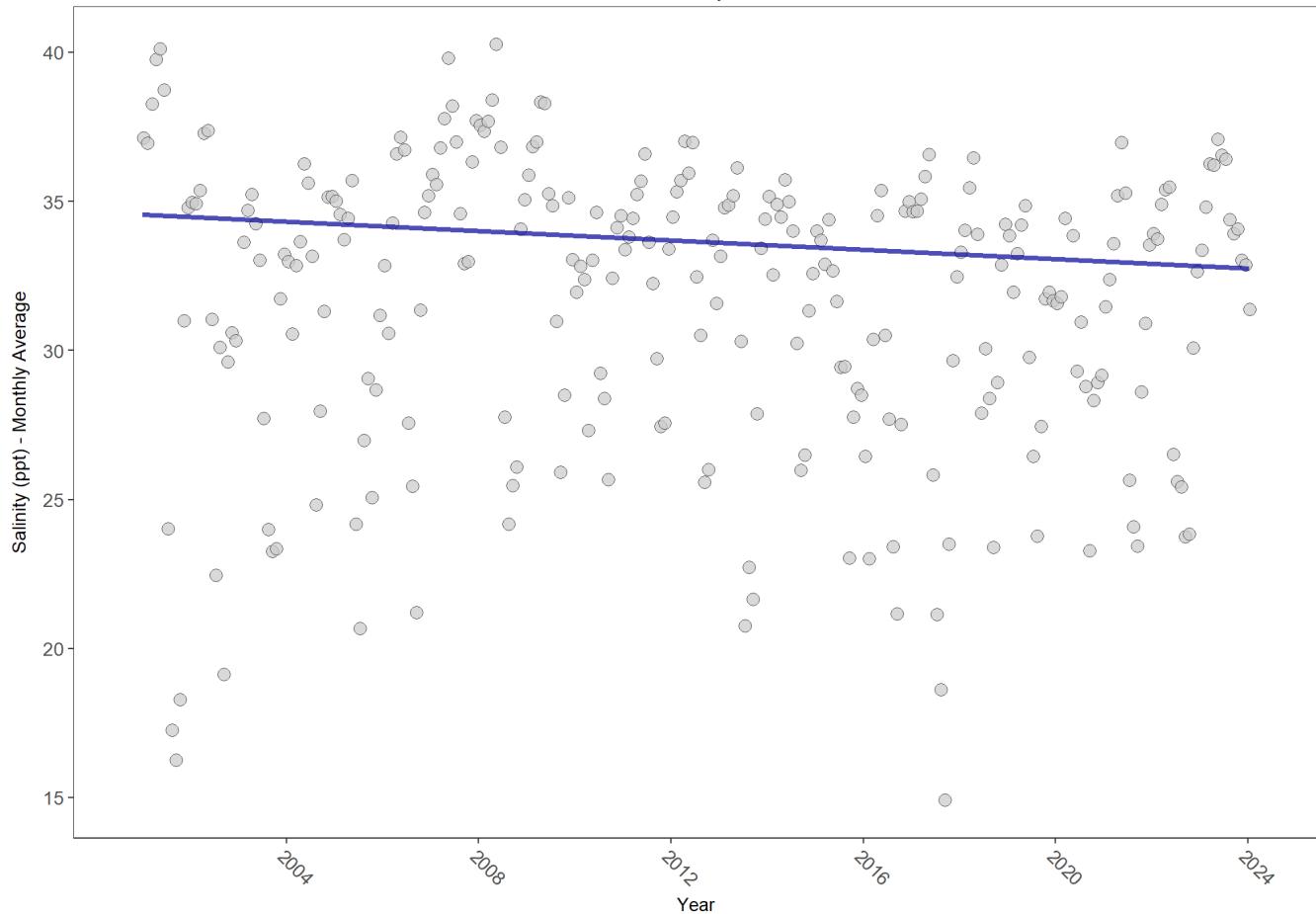
*SennIntercept is intercept value at beginning of record for monitoring location*

## Salinity - Continuous Water Quality

rkbhwq

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

Rookery Bay Aquatic Preserve  
rkbhwq  
Salinity



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
bottom	636274	24	33.2	TRUE	-0.1223	0.0049	-0.07850985	34.55144	13.2242	0.2789	-1

*p < 0.00005 appear as 0 due to rounding.*

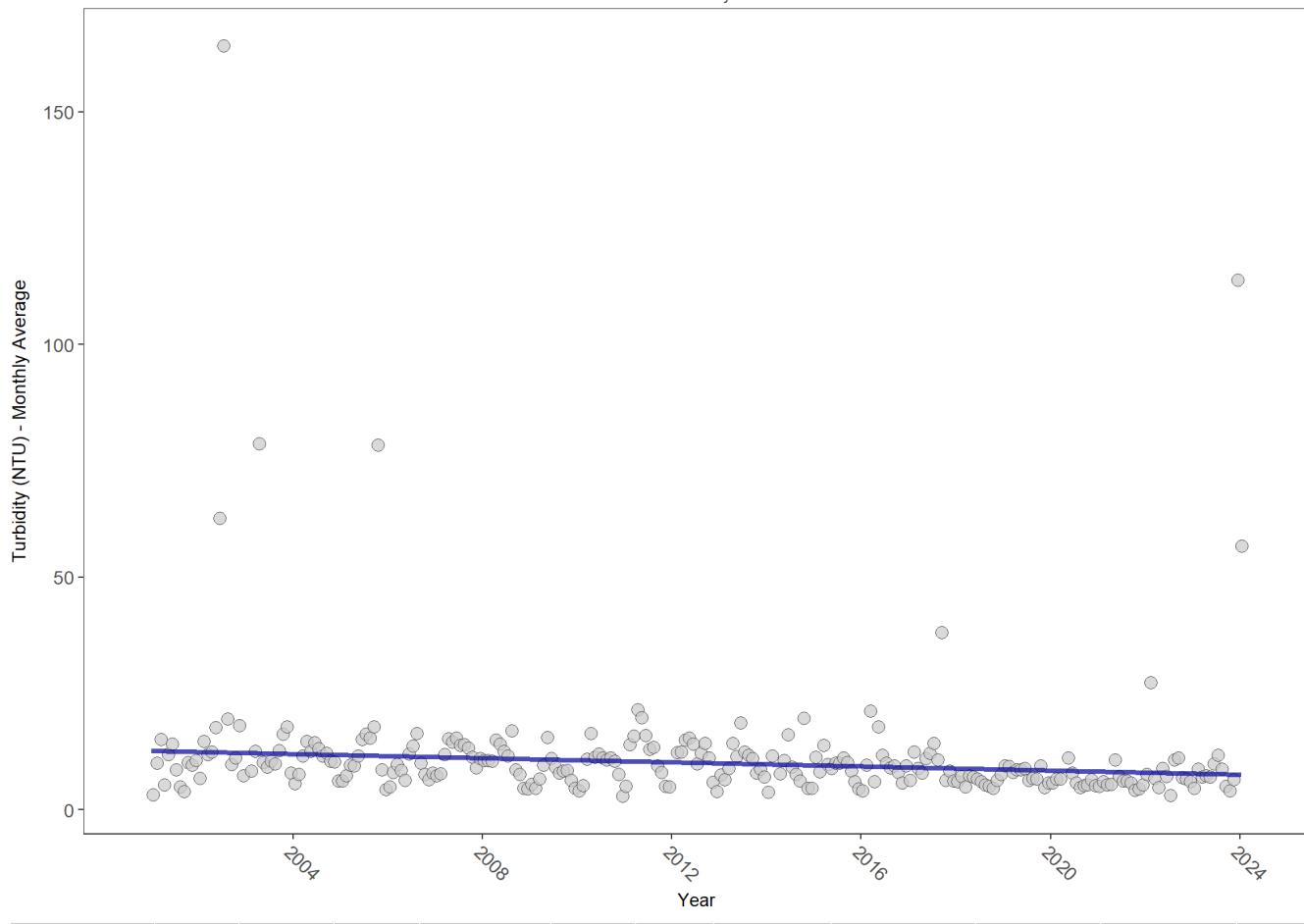
*SennIntercept is intercept value at beginning of record for monitoring location*

## Turbidity - Continuous Water Quality

rkbhwq

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

Rookery Bay Aquatic Preserve  
rkbhwq  
Turbidity



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
bottom	582924	24	8	TRUE	-0.2767	0.0000	-0.2203721	12.61183	19.4507	0.0535	-1

*p < 0.00005 appear as 0 due to rounding.*

*SennIntercept is intercept value at beginning of record for monitoring location*

## Water Temperature - Continuous Water Quality

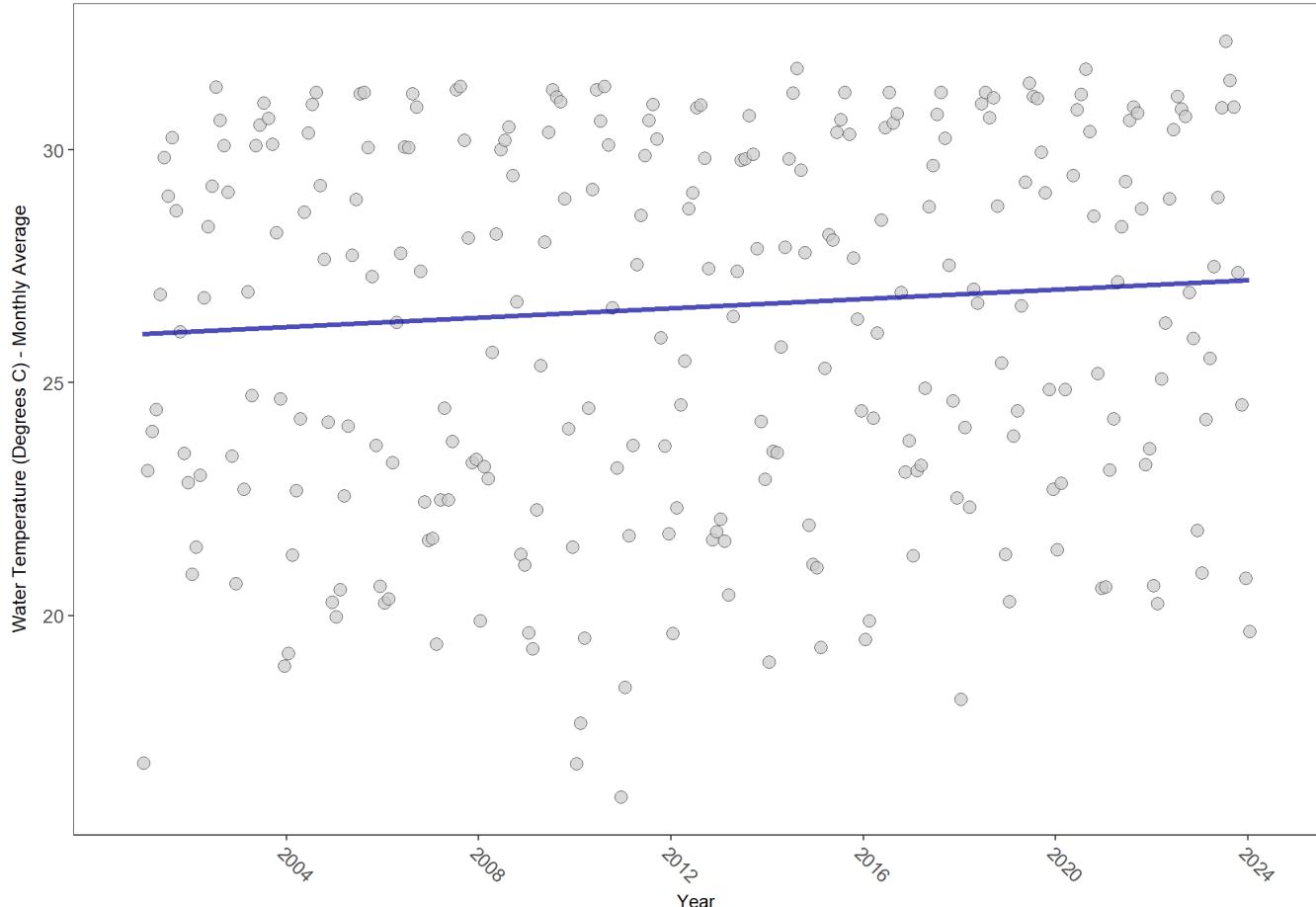
rkbhwq

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

Rookery Bay Aquatic Preserve

rkbhwq

Water Temperature



RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
bottom	667447	24	26.9	TRUE	0.2336	0.0000	0.04982675	26.05359	4.8776	0.9369	1

*p < 0.00005 appear as 0 due to rounding.*

*SennIntercept is intercept value at beginning of record for monitoring location*

# Submerged Aquatic Vegetation

The data file used is: **All\_SAV\_Parameters-2024-Feb-23.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.

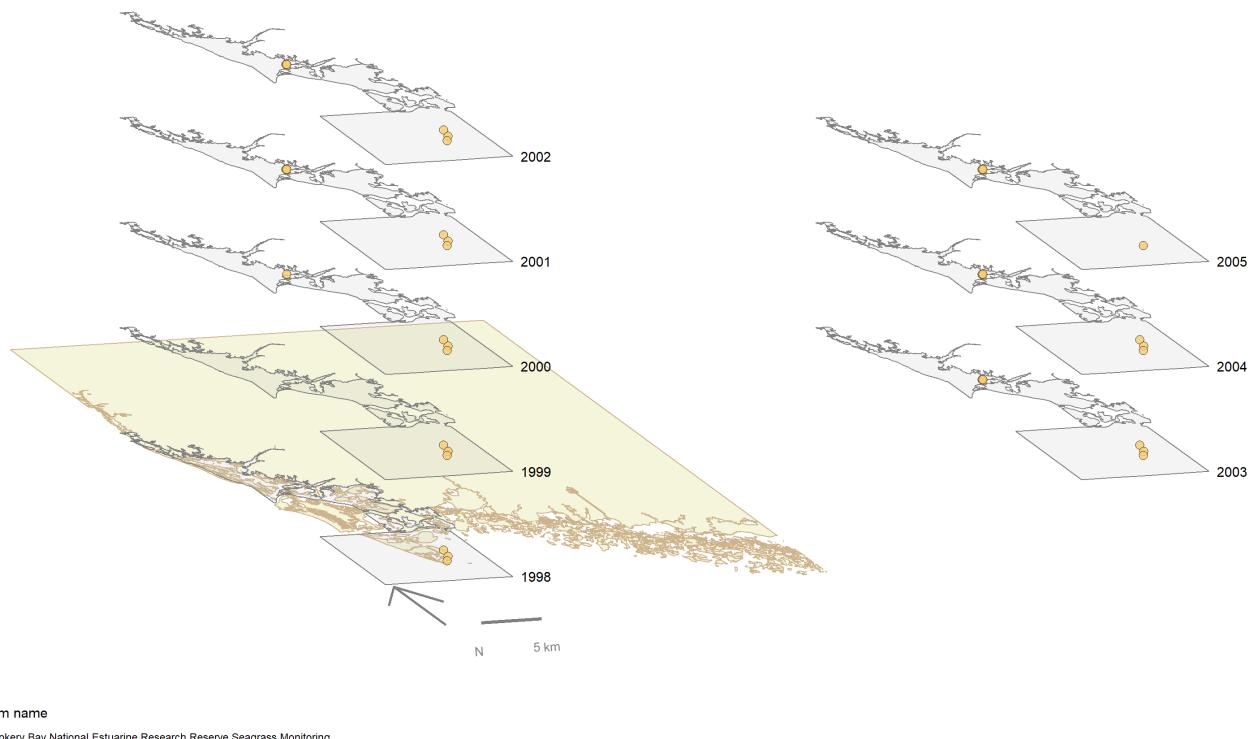
## Notes

*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

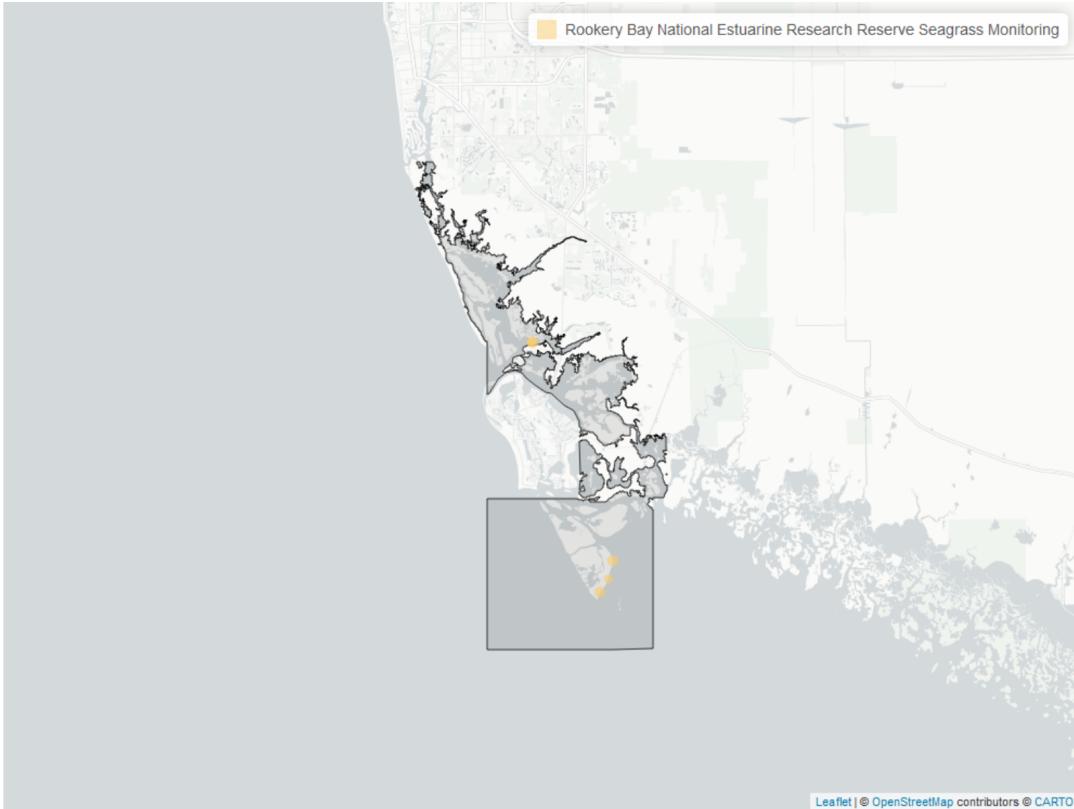
- Biscayne Bay Aquatic Preserve
- Florida Keys National Marine Sanctuary

Rookery Bay Aquatic Preserve  
SAV Percent Cover - Sample Locations



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

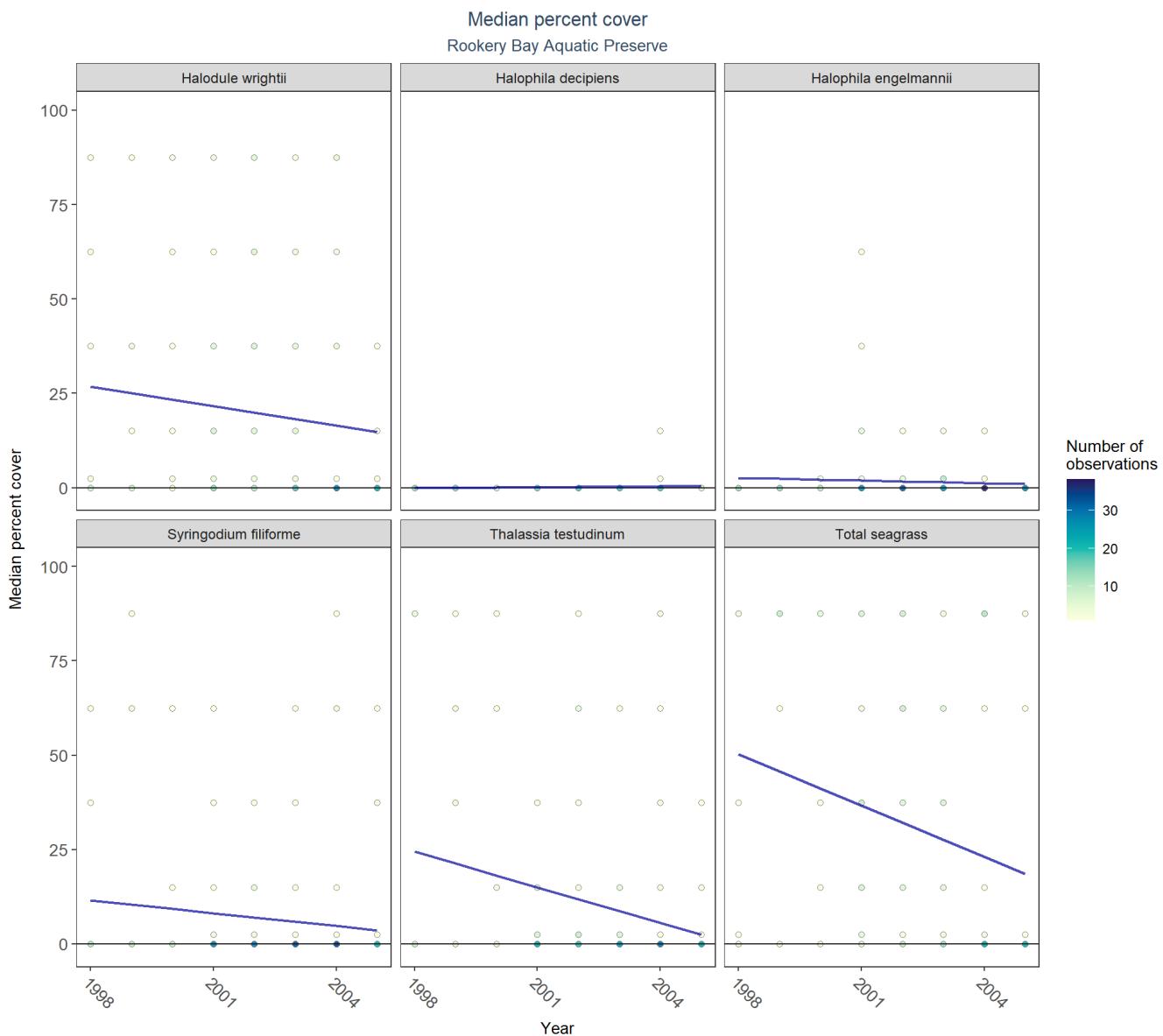
**Sampling locations by Program:**



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 26: Rookery Bay National Estuarine Research Reserve Seagrass Monitoring - *Program 572*

<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>	<i>Collection Method</i>	<i>Sample Locations</i>
1220	1998	2005	Percent Cover	6



Median percent cover by species in *Rookery Bay Aquatic Preserve*. Linear mixed-effects models are applied to each species to produce species trends. The trendlines are then isolated and reproduced below for ease of viewing. The LME results are available in table form beneath the supplemental trendplot below.

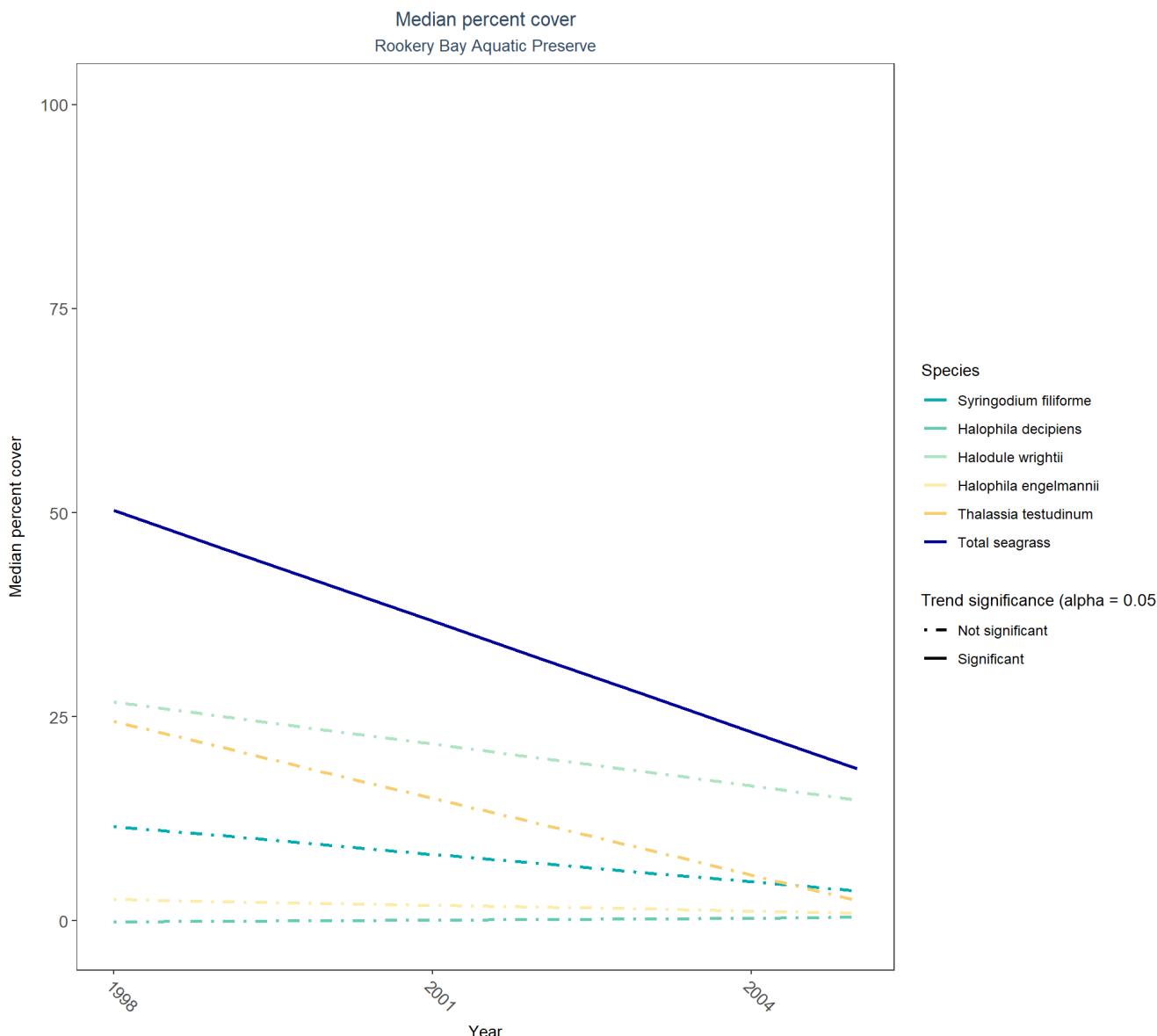
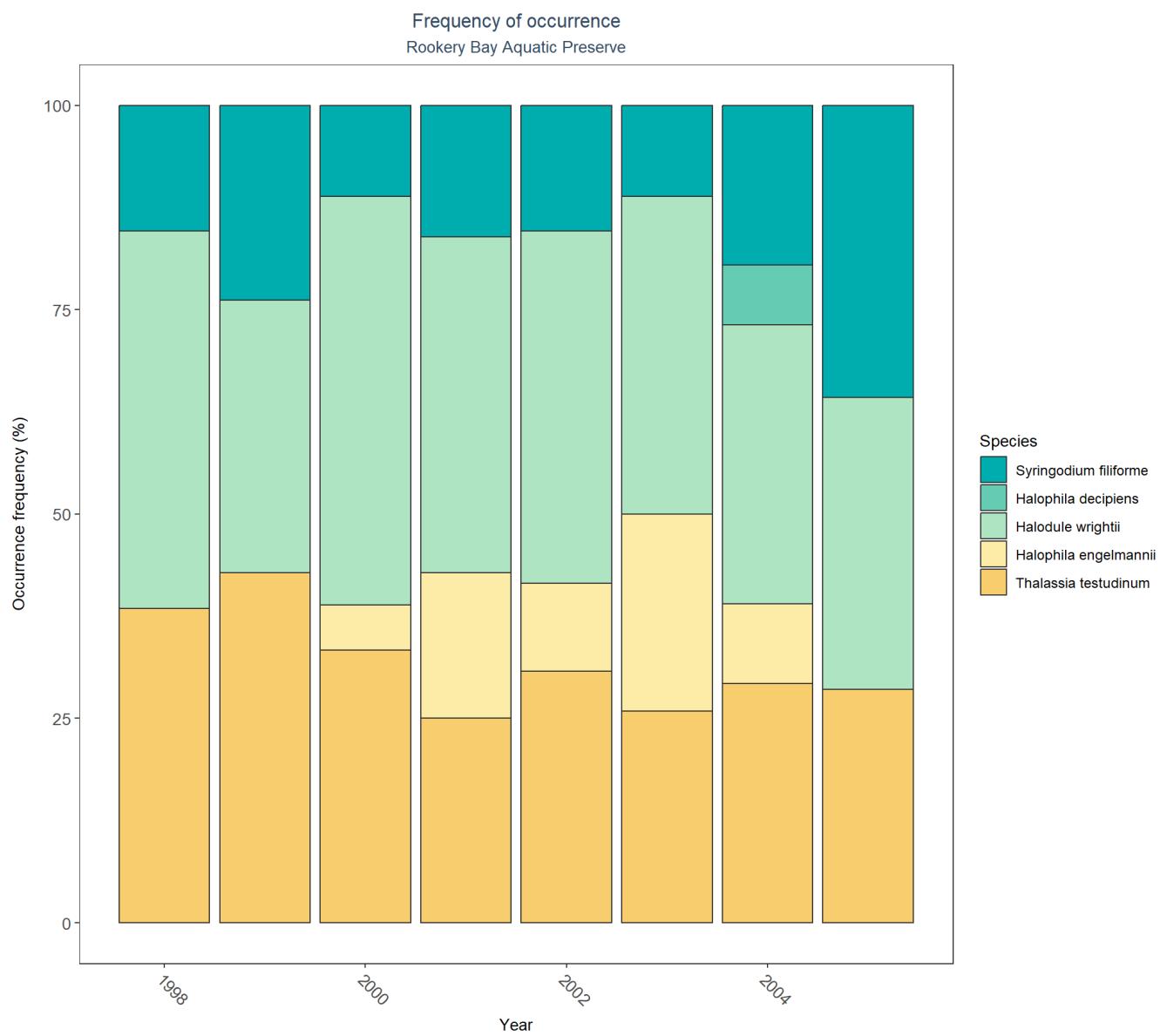


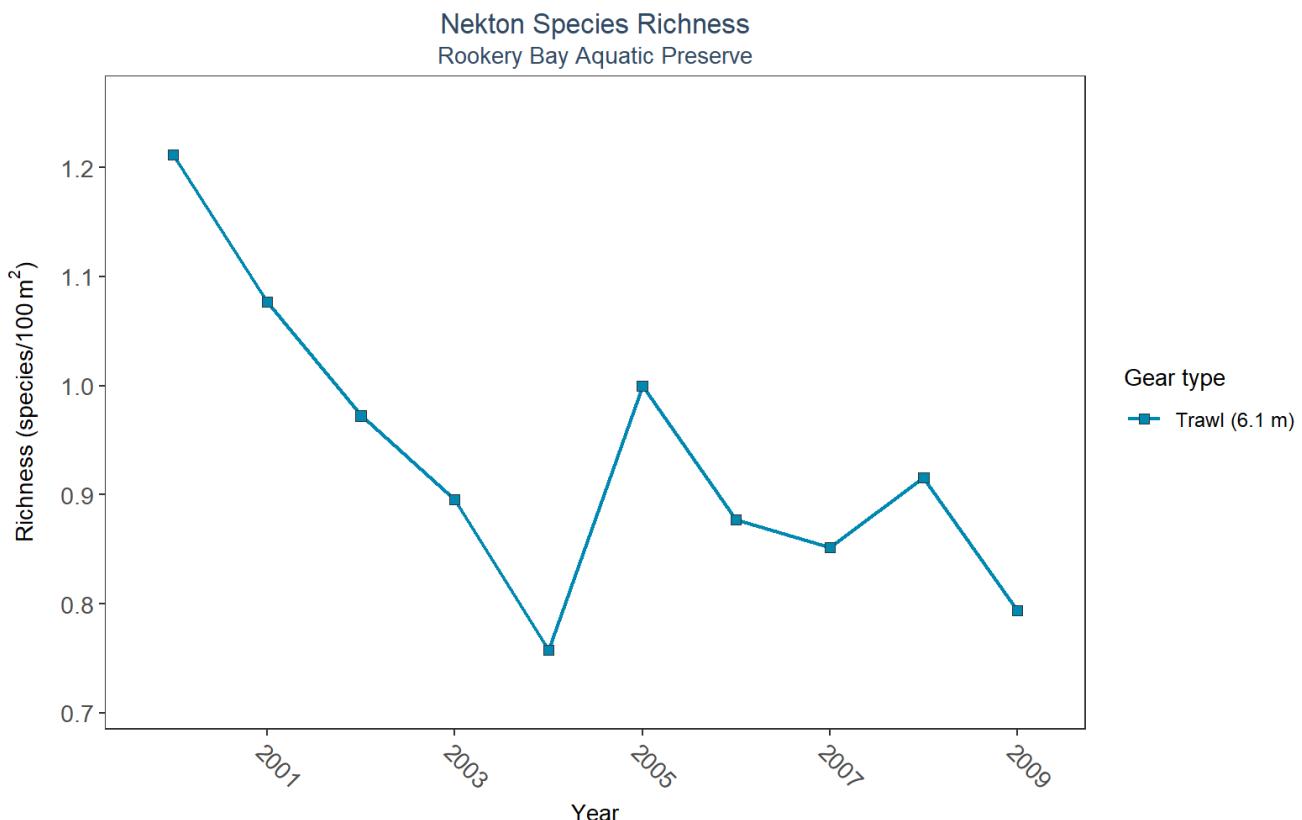
Table 27: Percent Cover Trend Analysis for Rookery Bay Aquatic Preserve

Species	Common Name	Trend Significance (0.05)	Period of Record	LME-Intercept	LME-Slope	p
Halodule wrightii	Shoal grass	No significant trend	1998 - 2005	33.6287	-1.7091	0.2546
Halophila decipiens	Paddle grass	No significant trend	1998 - 2005	-0.4446	0.0784	0.3563
Halophila engelmannii	Star grass	No significant trend	1998 - 2005	3.5305	-0.2323	0.4437
Syringodium filiforme	Manatee grass	No significant trend	1998 - 2005	16.1048	-1.1344	0.4001
Thalassia testudinum	Turtle grass	No significant trend	1998 - 2005	36.9899	-3.1381	0.0667
Total seagrass		Significantly decreasing trend	1998 - 2005	68.3694	-4.5210	0.0166



## Nekton

The data file used is: All\_NEKTON\_Parameters-2024-Feb-23.txt



GearType	GearSize_m	N_Years	EarliestYear	LatestYear	N_Data	Min	Max	Median	Mean	StDev	Year_MinRichness	Year_MaxRichness
Trawl	6.1	10	2000	2009	535	0	2.56	0.94	0.94	0.42	2004	2000