

# Indian River-Vero Beach to Ft. Pierce Aquatic Preserve

## SEACAR Habitat Analyses

Last compiled on 08 April, 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

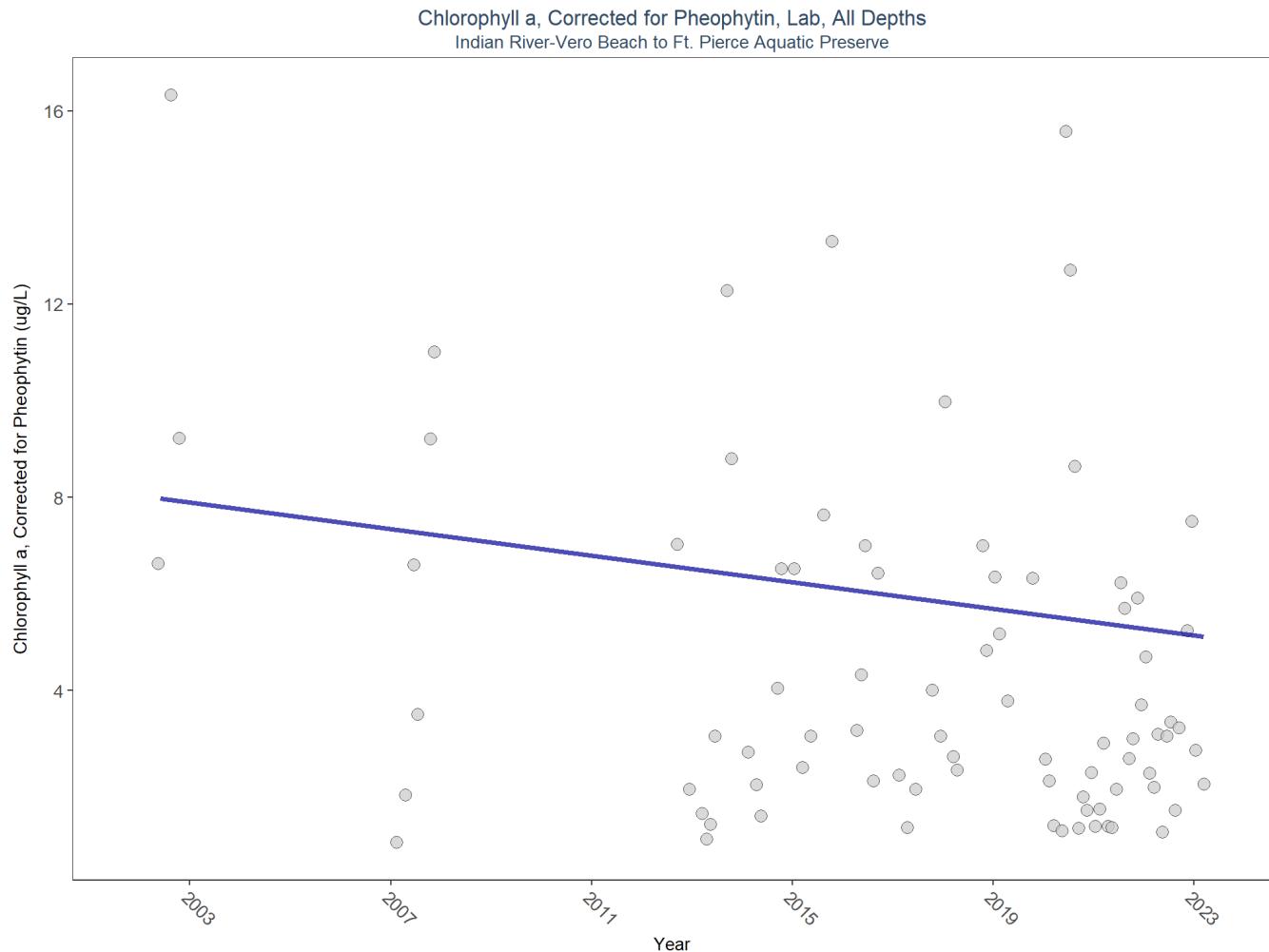
The following files were used in the discrete analysis:

- *Combined\_WQ\_WC\_NUT\_Chlorophyll\_a\_corrected\_for\_pheophytin-2024-Mar-27.txt*
- *Combined\_WQ\_WC\_NUT\_Chlorophyll\_a\_uncorrected\_for\_pheophytin-2024-Mar-27.txt*
- *Combined\_WQ\_WC\_NUT\_Colored\_dissolved\_organic\_matter\_CDOM-2024-Mar-27.txt*
- *Combined\_WQ\_WC\_NUT\_Dissolved\_Oxygen-2024-Mar-27.txt*
- *Combined\_WQ\_WC\_NUT\_Dissolved\_Oxygen\_Saturation-2024-Mar-27.txt*
- *Combined\_WQ\_WC\_NUT\_pH-2024-Mar-27.txt*
- *Combined\_WQ\_WC\_NUT\_Salinity-2024-Mar-27.txt*
- *Combined\_WQ\_WC\_NUT\_Secchi\_Depth-2024-Mar-27.txt*
- *Combined\_WQ\_WC\_NUT\_Total\_Nitrogen-2024-Mar-27.txt*
- *Combined\_WQ\_WC\_NUT\_Total\_Phosphorus-2024-Mar-27.txt*
- *Combined\_WQ\_WC\_NUT\_Total\_Suspended\_Solids\_TSS-2024-Mar-27.txt*
- *Combined\_WQ\_WC\_NUT\_Turbidity-2024-Mar-27.txt*
- *Combined\_WQ\_WC\_NUT\_Water\_Temperature-2024-Mar-27.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

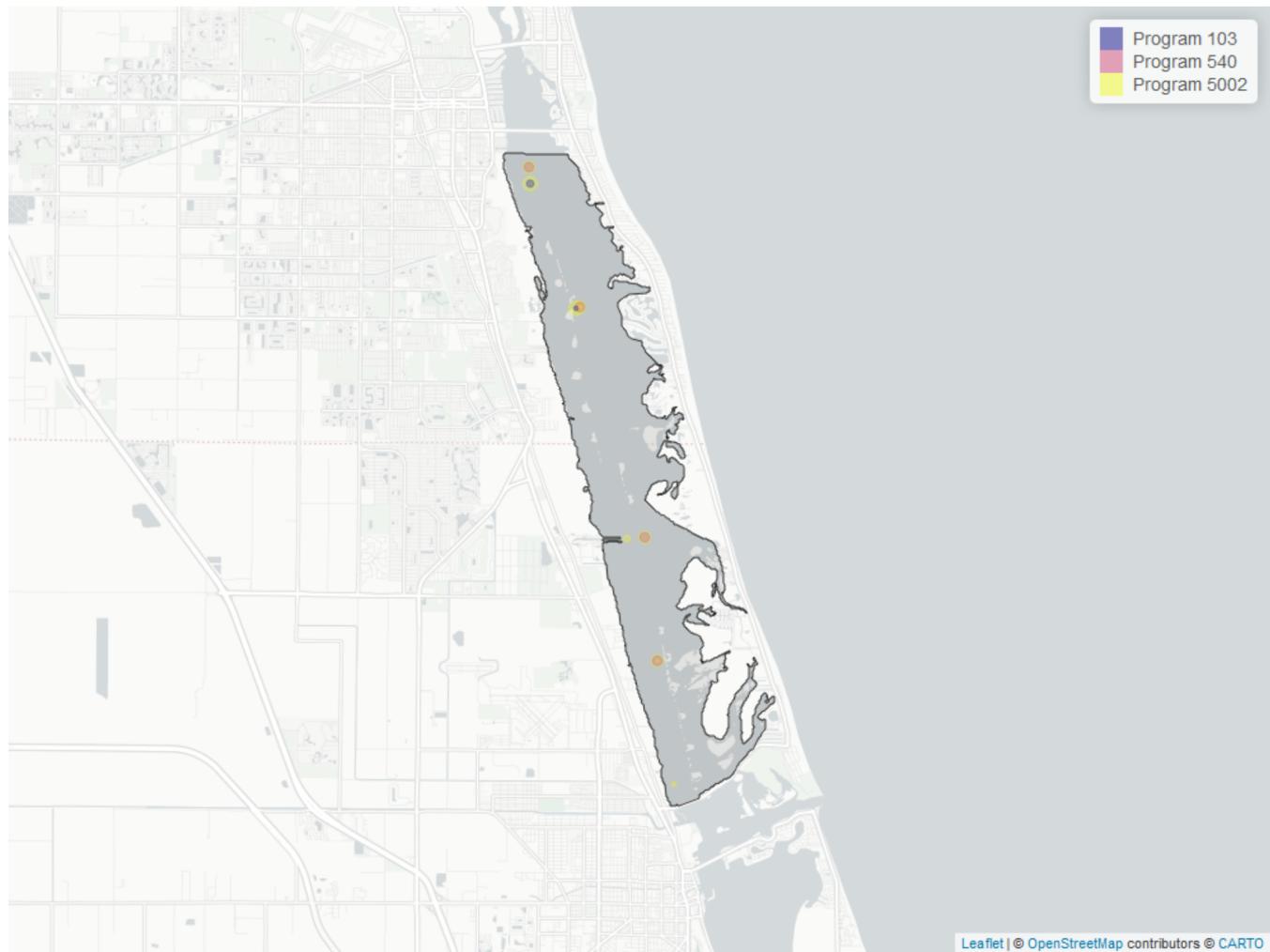


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	250	14	2.85	TRUE	-0.1997	0.0195	-0.1376125	8.035191	20.3453	0.0408	-1

*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 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	177	2002	2023
540	60	2016	2020
103	13	2020	2021

#### Program names:

5002 - Florida STORET / WIN

540 - Shellfish Harvest Area Classification Program

103 - EPA STOrage and RETrieval Data Warehouse (STORET)

#### 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

Year	$N_{Total}$	$N_I$	$perc_I$	$N_Q$	$perc_Q$	$N_U$	$perc_U$
2007	12	1	8.3			2	16.7
2012	8	2	25.0				
2013	20	9	45.0	2	10		
2014	20	3	15.0				
2016	20	1	5.0				
2017	20	8	40.0				
2018	20	1	5.0				
2020	30	18	60.0			2	6.7
2021	34	11	32.4			2	5.9
2022	22	11	50.0			1	4.6
2023	4	3	75.0				

**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>Q  
 - Sample held beyond the accepted holding time <sup>3</sup>U - Compound was analyzed for but not detected

**Programs containing Value Qualified data:**

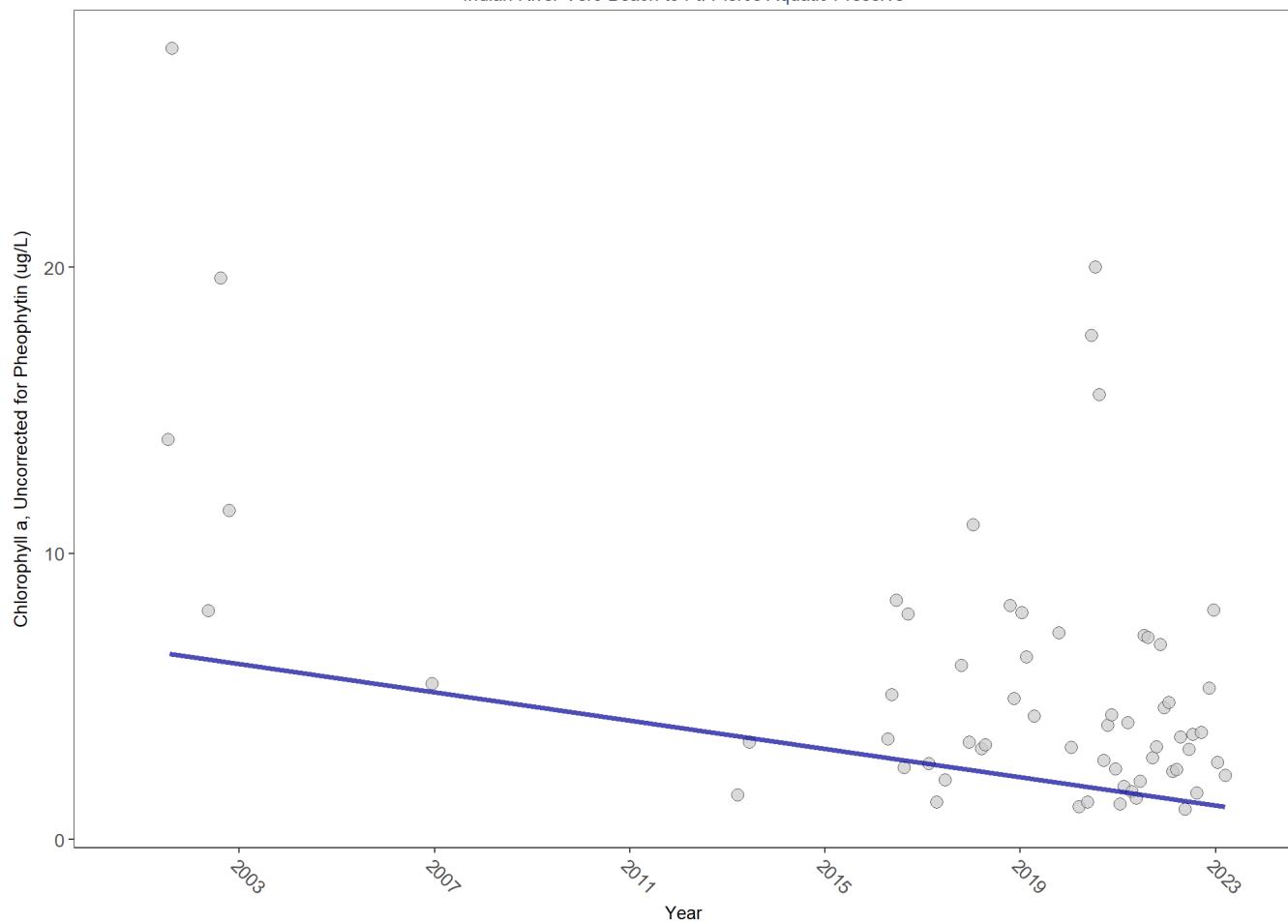
5002 - Florida STORET / WIN

540 - Shellfish Harvest Area Classification Program

# Chlorophyll a, Uncorrected for Pheophytin - Discrete Water Quality

## Seasonal Kendall-Tau Trend Analysis

Chlorophyll a, Uncorrected for Pheophytin, Lab, All Depths  
Indian River-Vero Beach to Ft. Pierce Aquatic Preserve

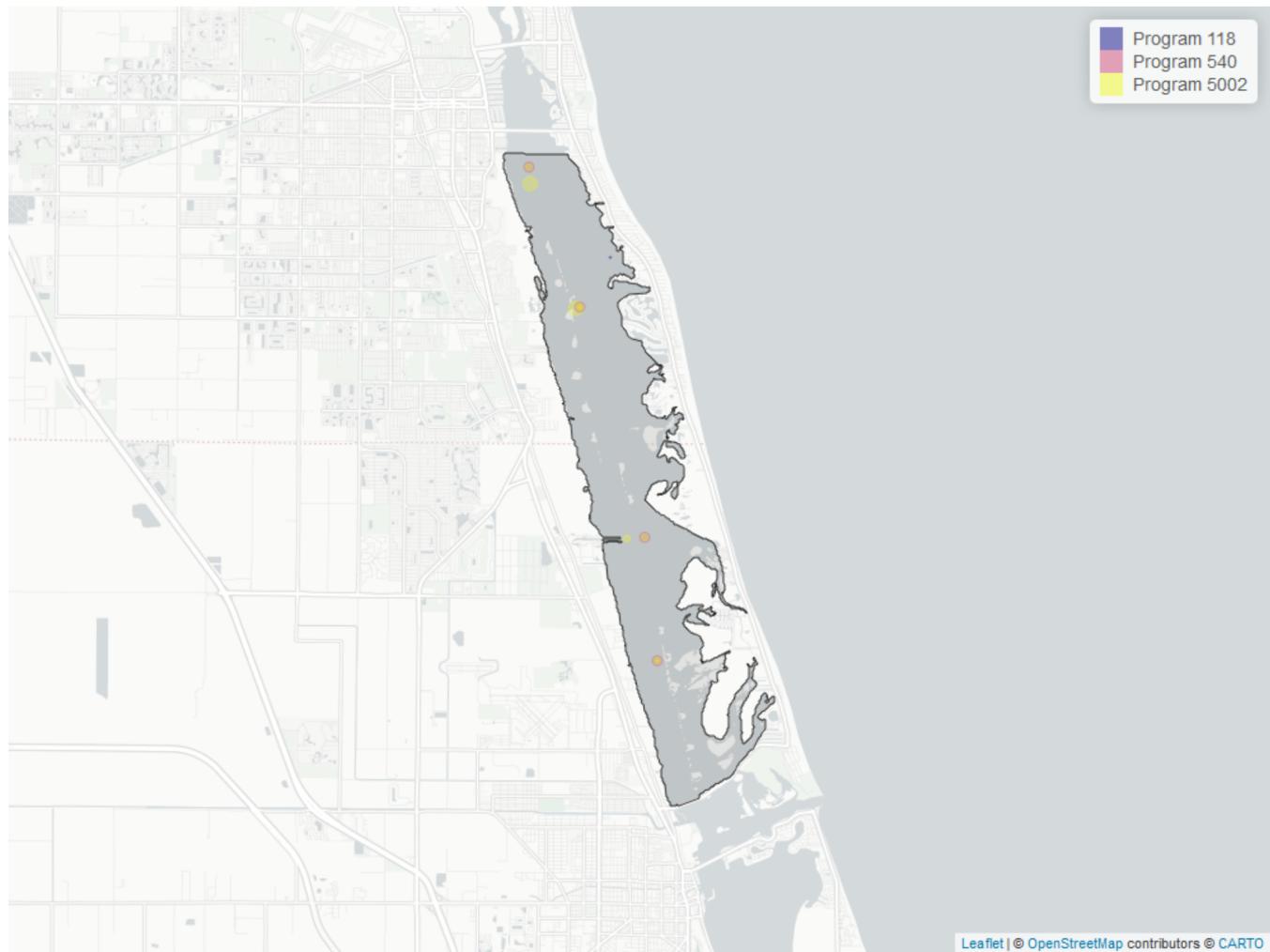


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	162	12	3.779835	TRUE	-0.2849	0.0115	-0.2478828	6.630123	12.9493	0.2967	-1

*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 Chlorophyll a, Uncorrected for Pheophytin



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

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

ProgramID	N_Data	YearMin	YearMax
5002	105	2001	2023
540	60	2016	2020
118	1	2006	2006

**Program names:**

5002 - Florida STORET / WIN

540 - Shellfish Harvest Area Classification Program

118 - National Aquatic Resource Surveys, National Coastal Condition Assessment

**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 Pheo-phytin

<i>Year</i>	<i>N_Total</i>	<i>N_I</i>	<i>perc_I</i>	<i>N_U</i>	<i>perc_U</i>
2013	4	1	25.0		
2017	20	1	5.0		
2020	28	8	28.6		
2021	23	12	52.2		
2022	22	10	45.5	1	4.6
2023	4	2	50.0		

**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:

540 - Shellfish Harvest Area Classification Program

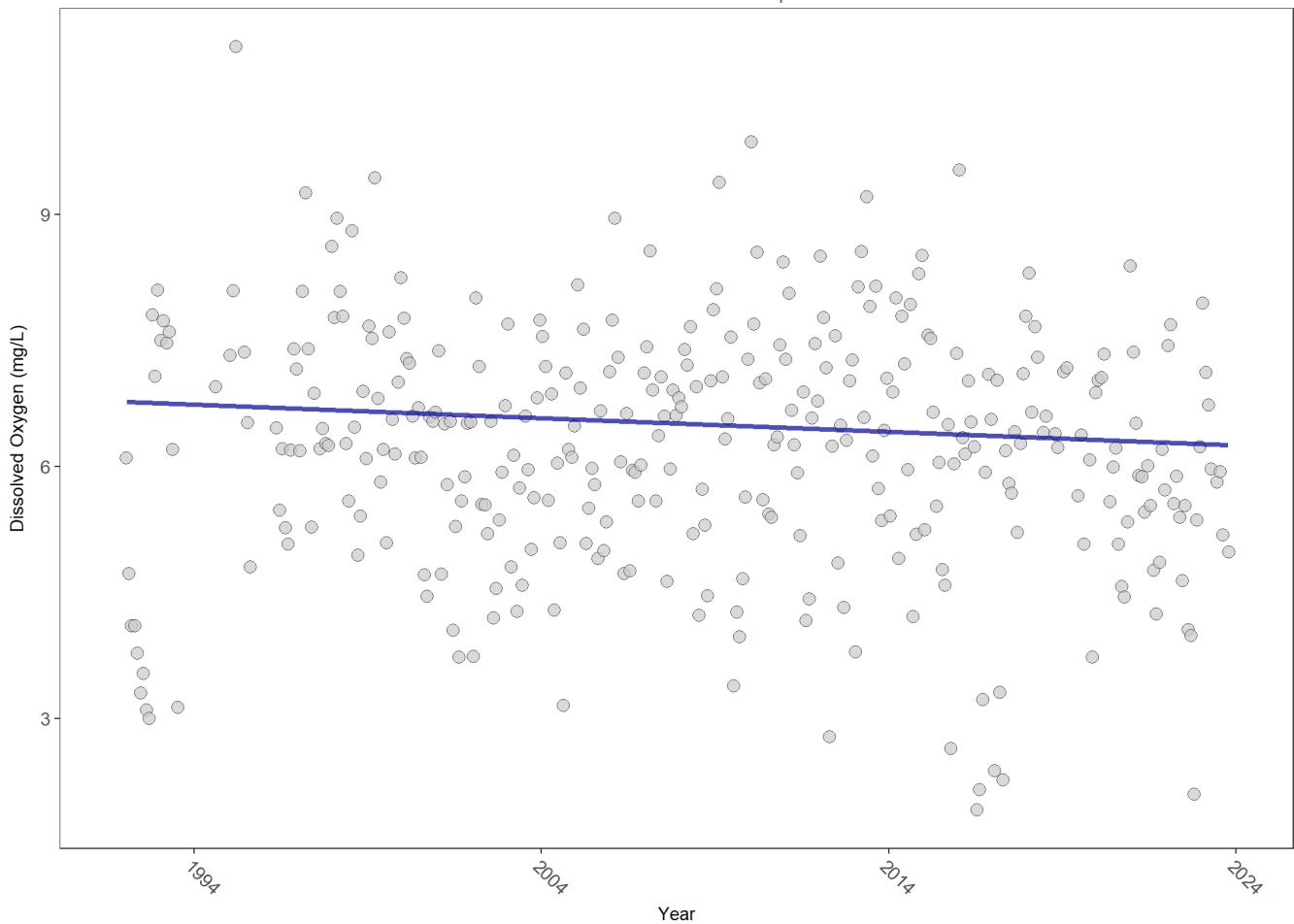
5002 - Florida STORET / WIN

### 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

Dissolved Oxygen, Field, All Depths  
Indian River-Vero Beach to Ft. Pierce Aquatic Preserve

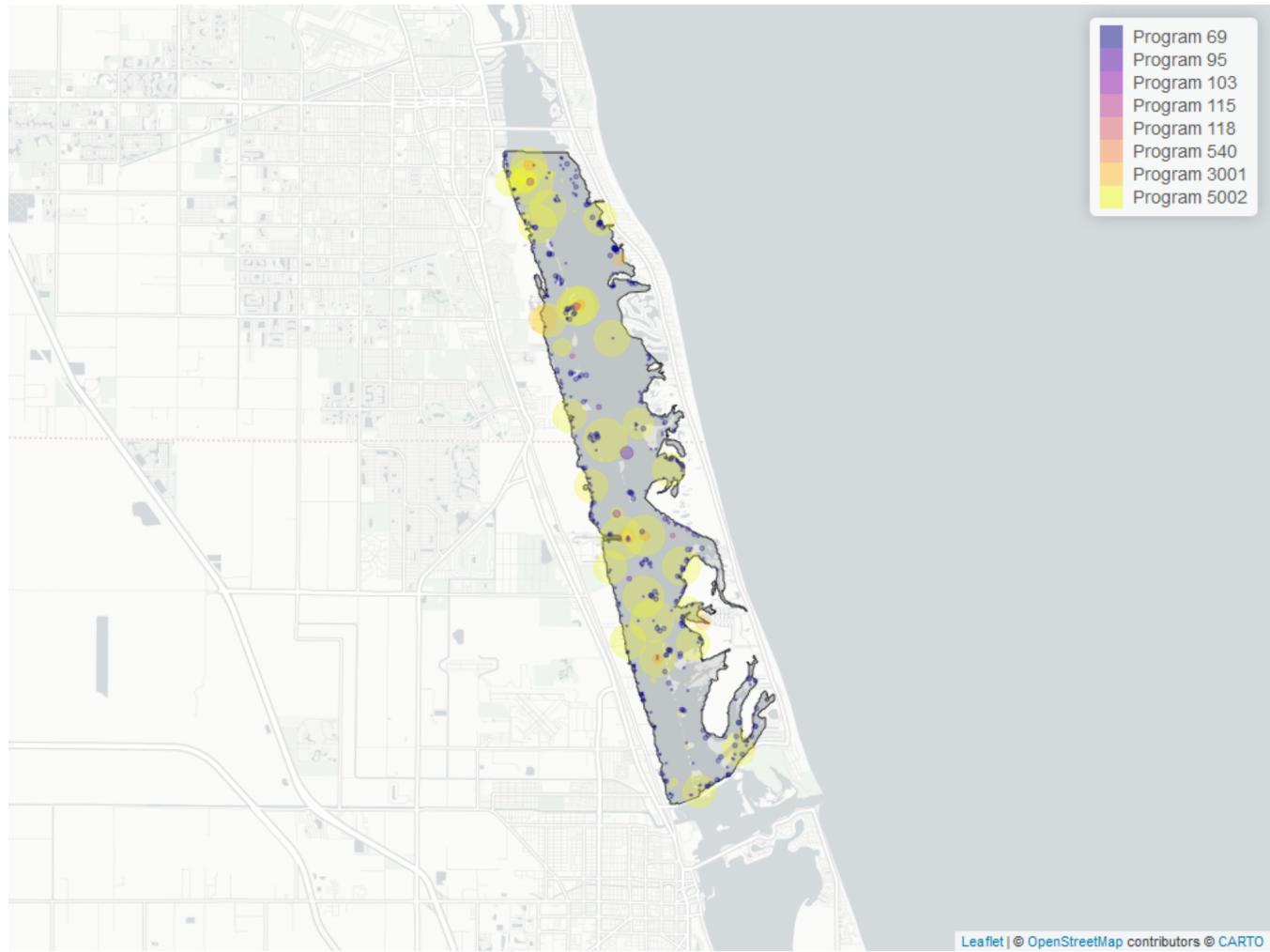


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	7660	32	6.22	TRUE	-0.0901	0.0206	-0.01612782	6.767998	8.5388	0.6644	-1

*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 Dissolved Oxygen



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

Table 10: Programs contributing data for Dissolved Oxygen

ProgramID	N_Data	YearMin	YearMax
5002	5904	1995	2023
69	1038	1998	2017
3013	376	1999	2023
3001	217	1992	2022
95	60	1996	2018
540	56	2016	2020
103	21	2020	2021
115	8	1994	1995
118	1	2006	2006

**Program names:**

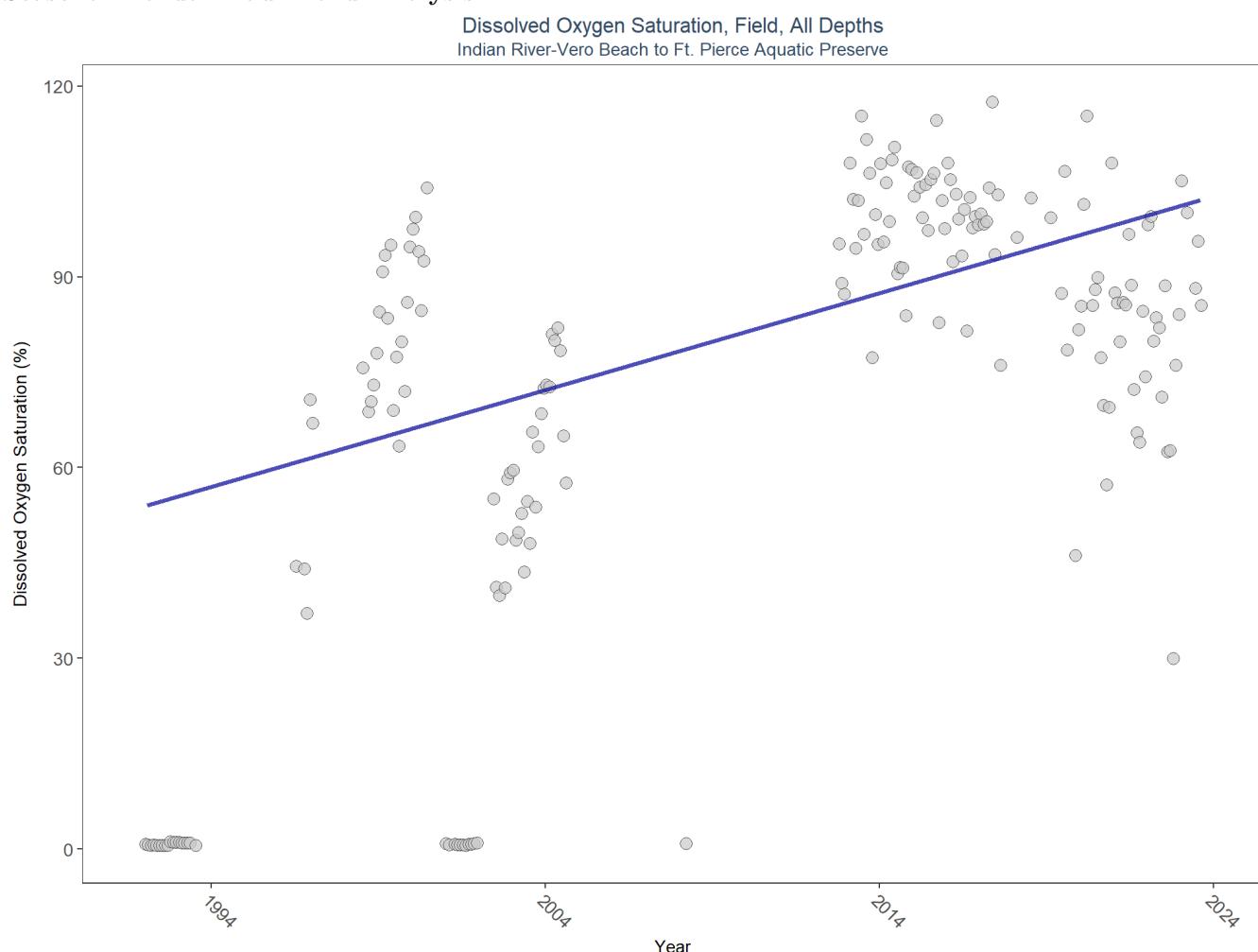
5002 - Florida STORET / WIN  
 69 - Fisheries-Independent Monitoring (FIM) Program

3013 - Seagrass (SJRWMD)  
 3001 - Lagoon Watch (Formerly Marine Discovery Center)  
 95 - Harmful Algal Bloom Marine Observation Network  
 540 - Shellfish Harvest Area Classification Program  
 103 - EPA STOrage and RETrieval Data Warehouse (STORET)  
 115 - Environmental Monitoring Assessment Program  
 118 - National Aquatic Resource Surveys, National Coastal Condition Assessment

There are no qualifying Value Qualifiers for Dissolved Oxygen in Indian River-Vero Beach to Ft. Pierce Aquatic Preserve

## Dissolved Oxygen Saturation - Discrete Water Quality

### Seasonal Kendall-Tau Trend Analysis

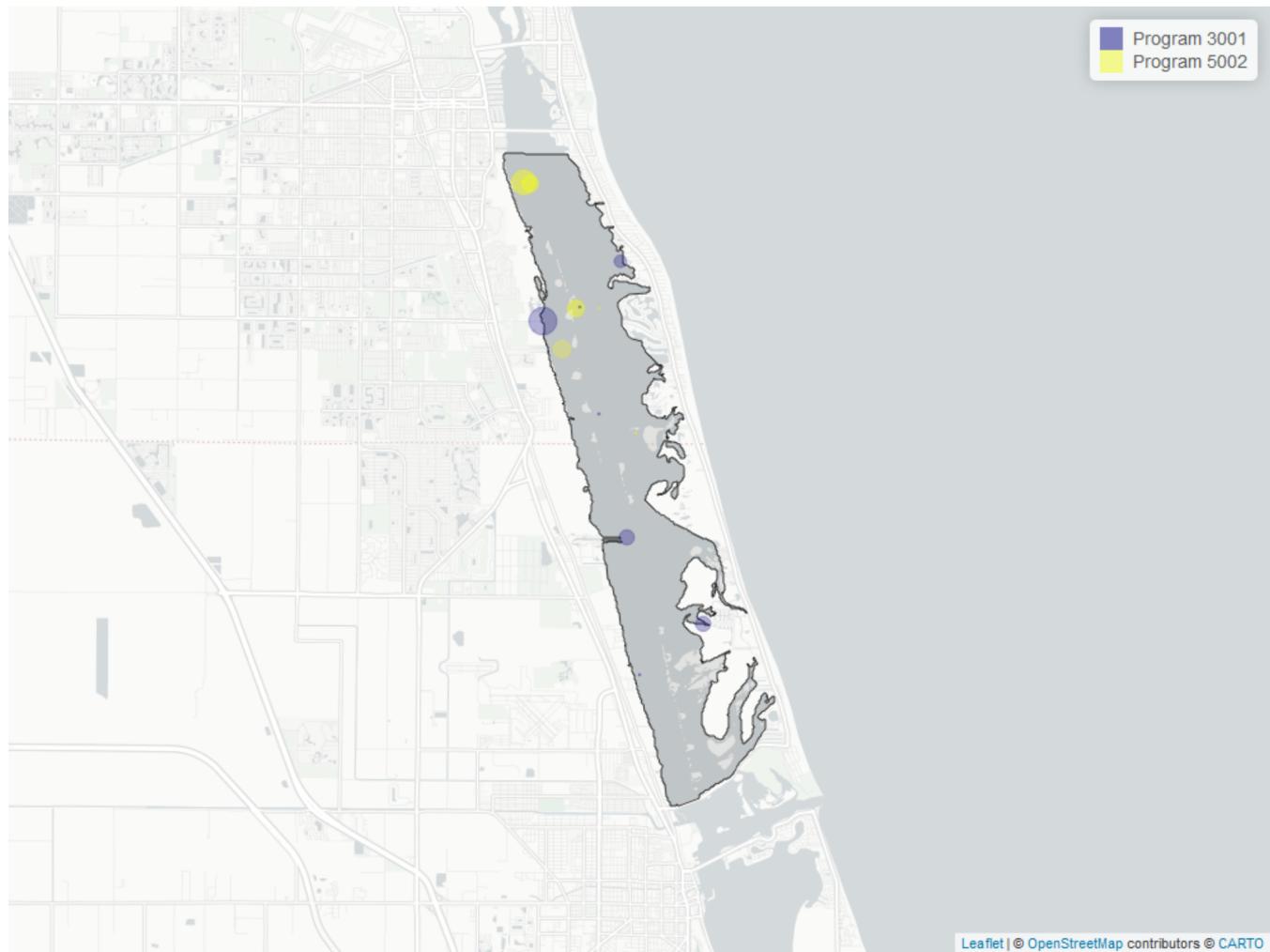


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	797	24	83	TRUE	0.3691	0.0000	1.522059	53.95132	5.12	0.9252	1

*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 Dissolved Oxygen Saturation



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 Saturation

ProgramID	N_Data	YearMin	YearMax
5002	398	1996	2023
3001	213	1992	2022
3013	186	2012	2023

#### Program names:

5002 - Florida STORET / WIN

3001 - Lagoon Watch (Formerly Marine Discovery Center)

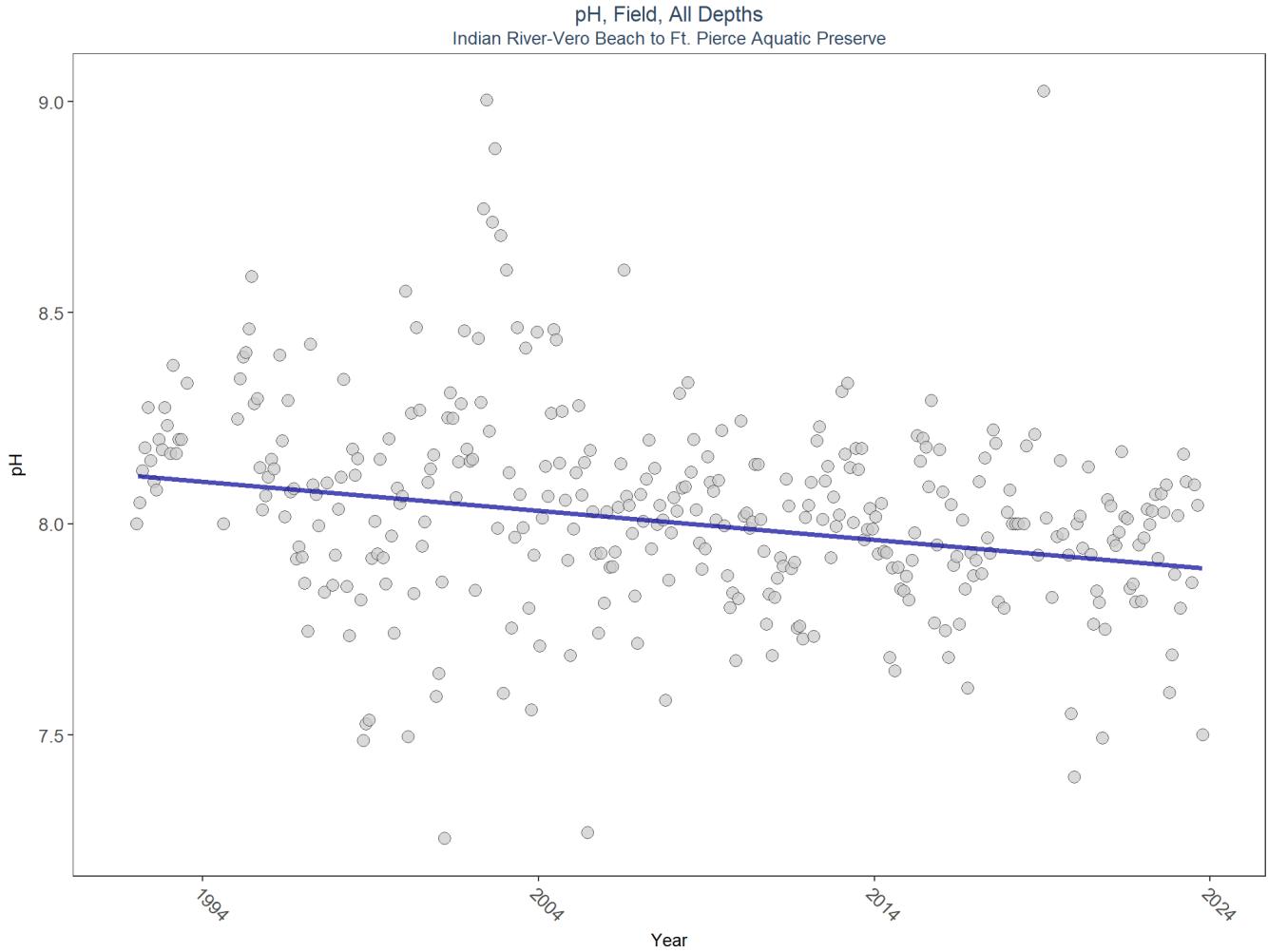
3013 - Seagrass (SJRWMD)

There are no qualifying Value Qualifiers for Dissolved Oxygen Saturation in Indian River-Vero Beach to Ft. Pierce 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.

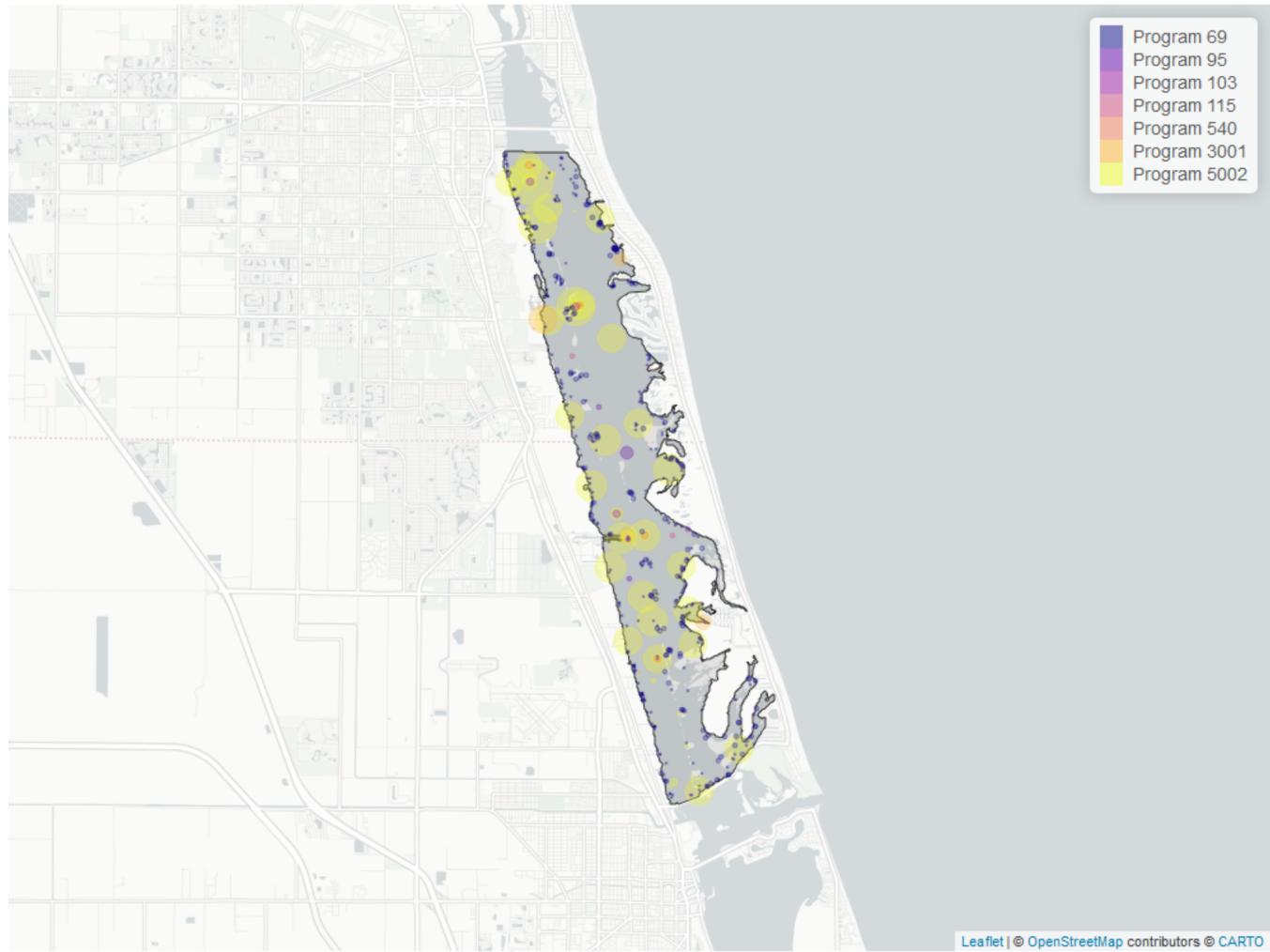
### Seasonal Kendall-Tau Trend Analysis



*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 12: Programs contributing data for pH

ProgramID	N_Data	YearMin	YearMax
5002	4091	1995	2023
69	1024	1998	2017
3013	374	2003	2023
3001	219	1992	2022
95	53	2002	2018
540	48	2016	2020
103	21	2020	2021
115	6	1994	1995

**Program names:**

5002 - Florida STORET / WIN

69 - Fisheries-Independent Monitoring (FIM) Program

3013 - Seagrass (SJRWMD)

3001 - Lagoon Watch (Formerly Marine Discovery Center)

95 - Harmful Algal Bloom Marine Observation Network

540 - Shellfish Harvest Area Classification Program

103 - EPA STOrage and RETrieval Data Warehouse (STORET)

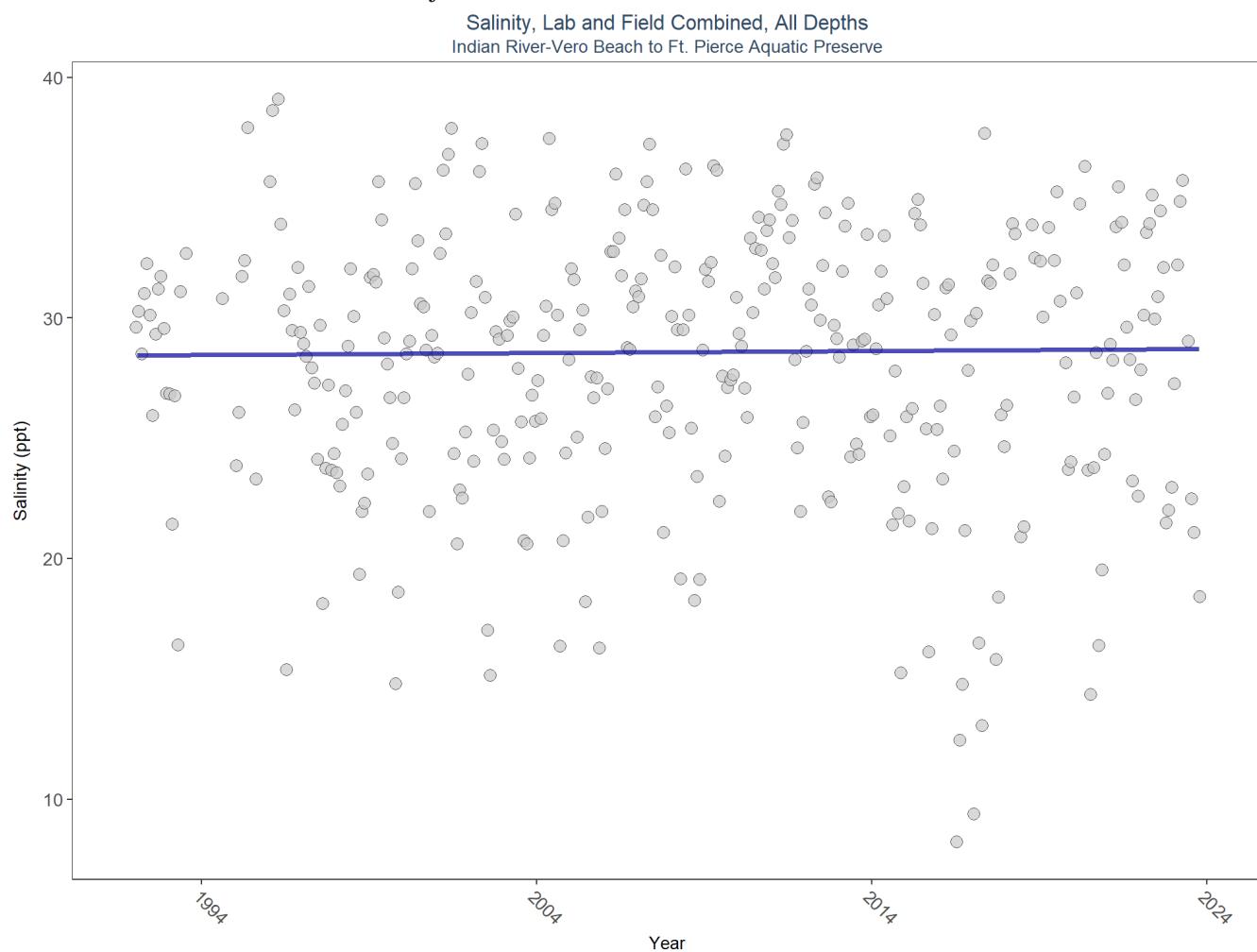
115 - Environmental Monitoring Assessment Program

There are no qualifying Value Qualifiers for pH in Indian River-Vero Beach to Ft. Pierce 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

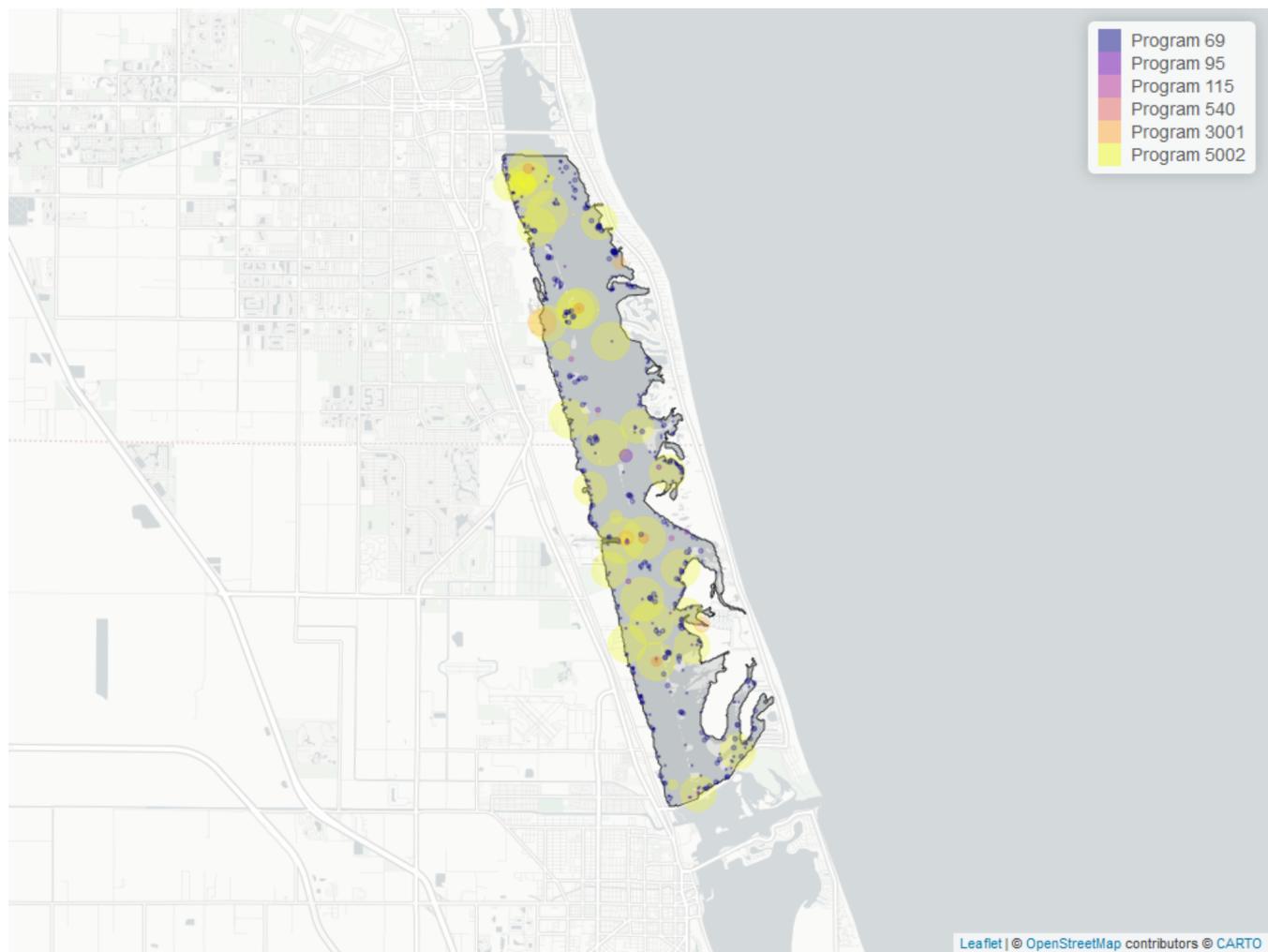


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	8369	32	29.01	TRUE	0.0061	0.8376	0.007999516	28.45982	8.1637	0.6986	0

*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 13: Programs contributing data for Salinity

ProgramID	N_Data	YearMin	YearMax
5002	6576	1995	2023
69	1076	1997	2017
3013	376	2003	2023
3001	217	1992	2022
95	68	1996	2018
540	60	2016	2020
115	7	1994	1995

**Program names:**

5002 - Florida STORET / WIN

69 - Fisheries-Independent Monitoring (FIM) Program

3013 - Seagrass (SJRWMD)

3001 - Lagoon Watch (Formerly Marine Discovery Center)

95 - Harmful Algal Bloom Marine Observation Network

540 - Shellfish Harvest Area Classification Program

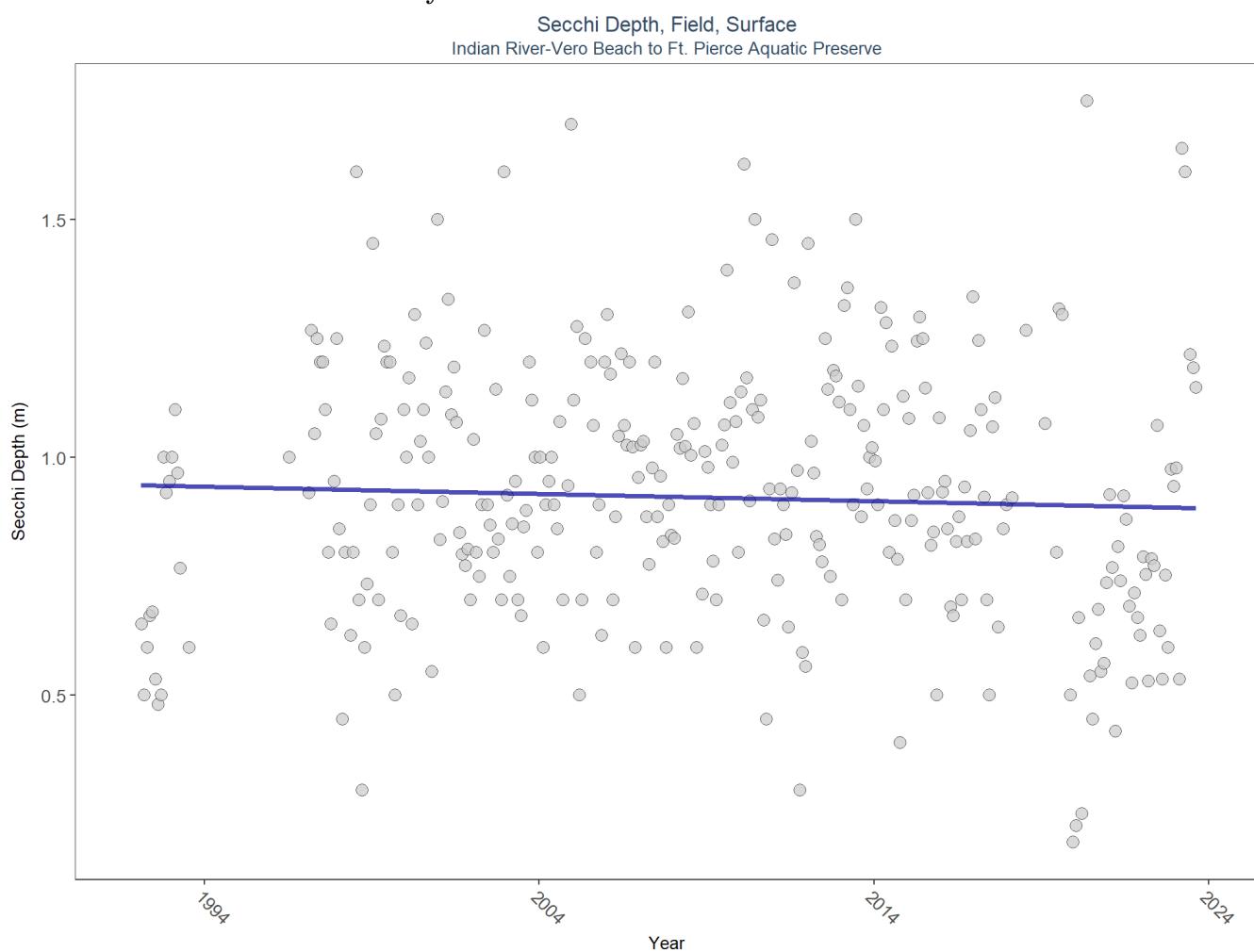
115 - Environmental Monitoring Assessment Program

There are no qualifying Value Qualifiers for Salinity in Indian River-Vero Beach to Ft. Pierce 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



*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

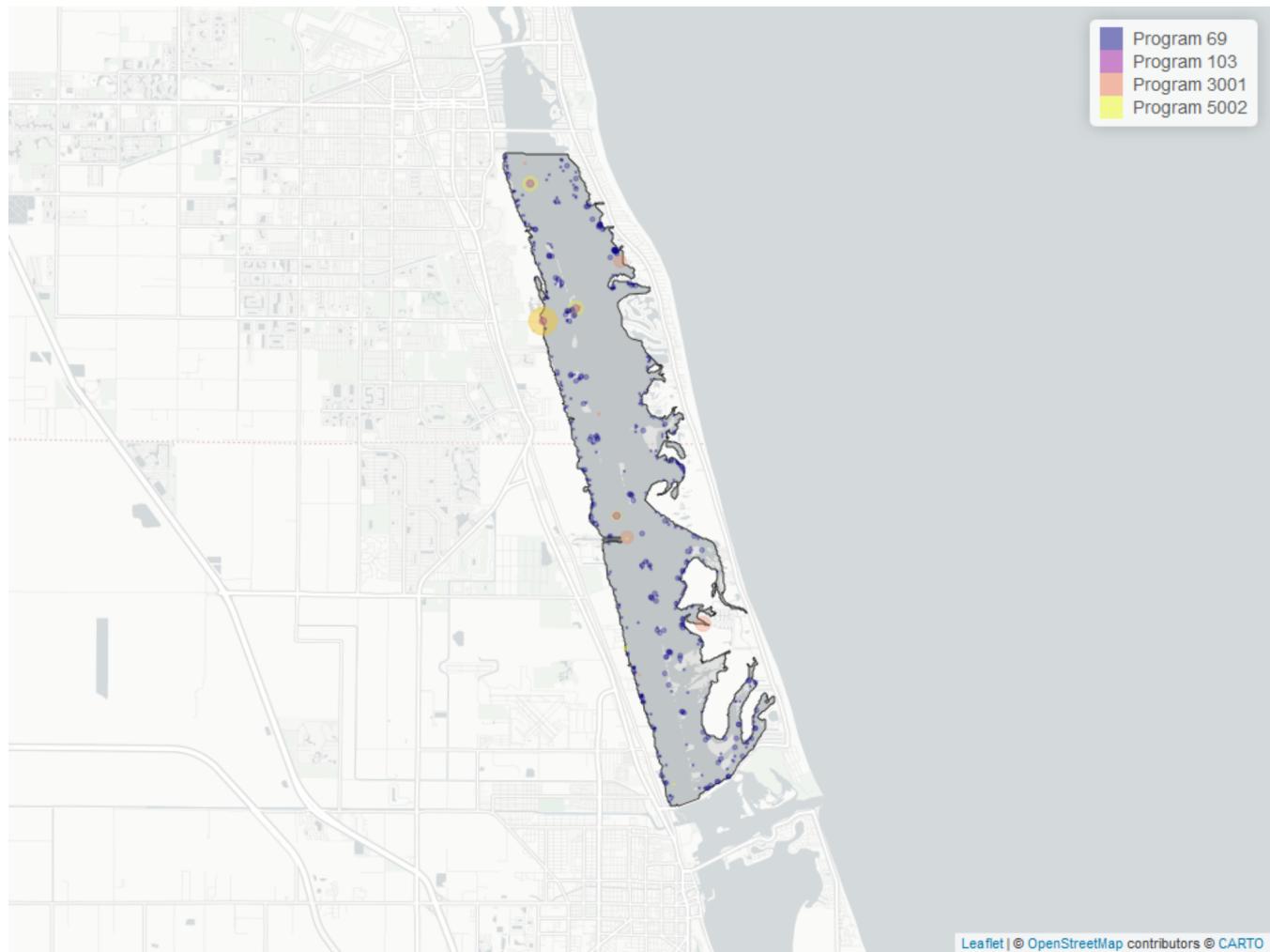


Table 14: Programs contributing data for Secchi Depth

ProgramID	N_Data	YearMin	YearMax
69	1078	1997	2017
3013	369	2003	2023
5002	209	2007	2023
3001	204	1992	2022
103	29	2020	2021

#### Program names:

69 - Fisheries-Independent Monitoring (FIM) Program

3013 - Seagrass (SJRWMD)

5002 - Florida STORET / WIN

3001 - Lagoon Watch (Formerly Marine Discovery Center)

### 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 15: Value Qualifiers for Secchi Depth

Year	$N_{\_Total}$	$N_{\_S}$	$perc_{\_S}$
2019	26	4	15.4
2020	110	33	30.0
2021	149	44	29.5
2022	99	32	32.3
2023	29	12	41.4

**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.

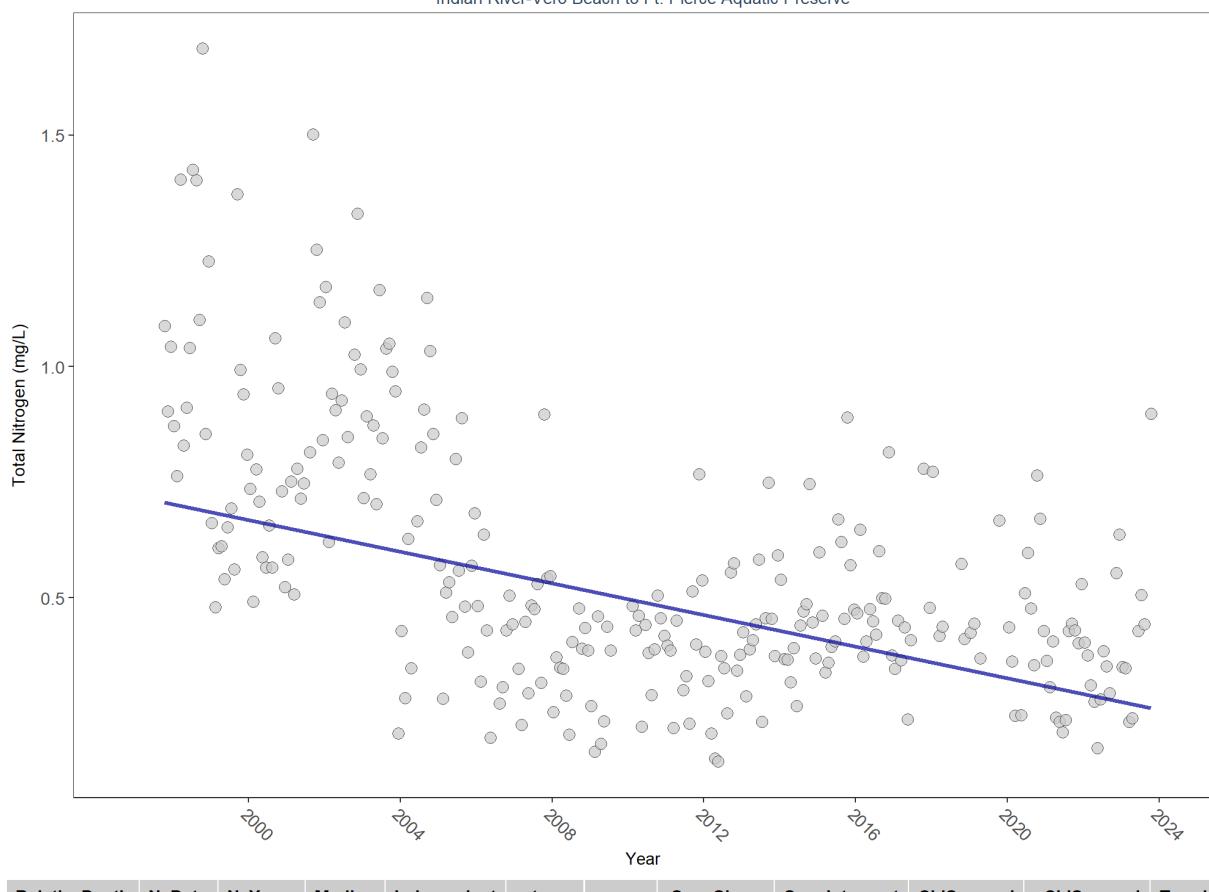
- 1)  $TN = TKN + NO_3O_2;$
- 2)  $TN = TKN + NO_3 + NO_2;$
- 3)  $TN = ORGN + NH_4 + NO_3O_2;$
- 4)  $TN = ORGN + NH_4 + NO_2 + NO_3;$
- 5)  $TN = TKN + NO_3;$
- 6)  $TN = ORGN + NH_4 + NO_3;$

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\_QAQCFlagCode = “1Q”
  - SEACAR\_QAQC\_Description = “SEACAR Calculated”

## Seasonal Kendall-Tau Trend Analysis

Total Nitrogen, Lab, All Depths  
Indian River-Vero Beach to Ft. Pierce Aquatic Preserve

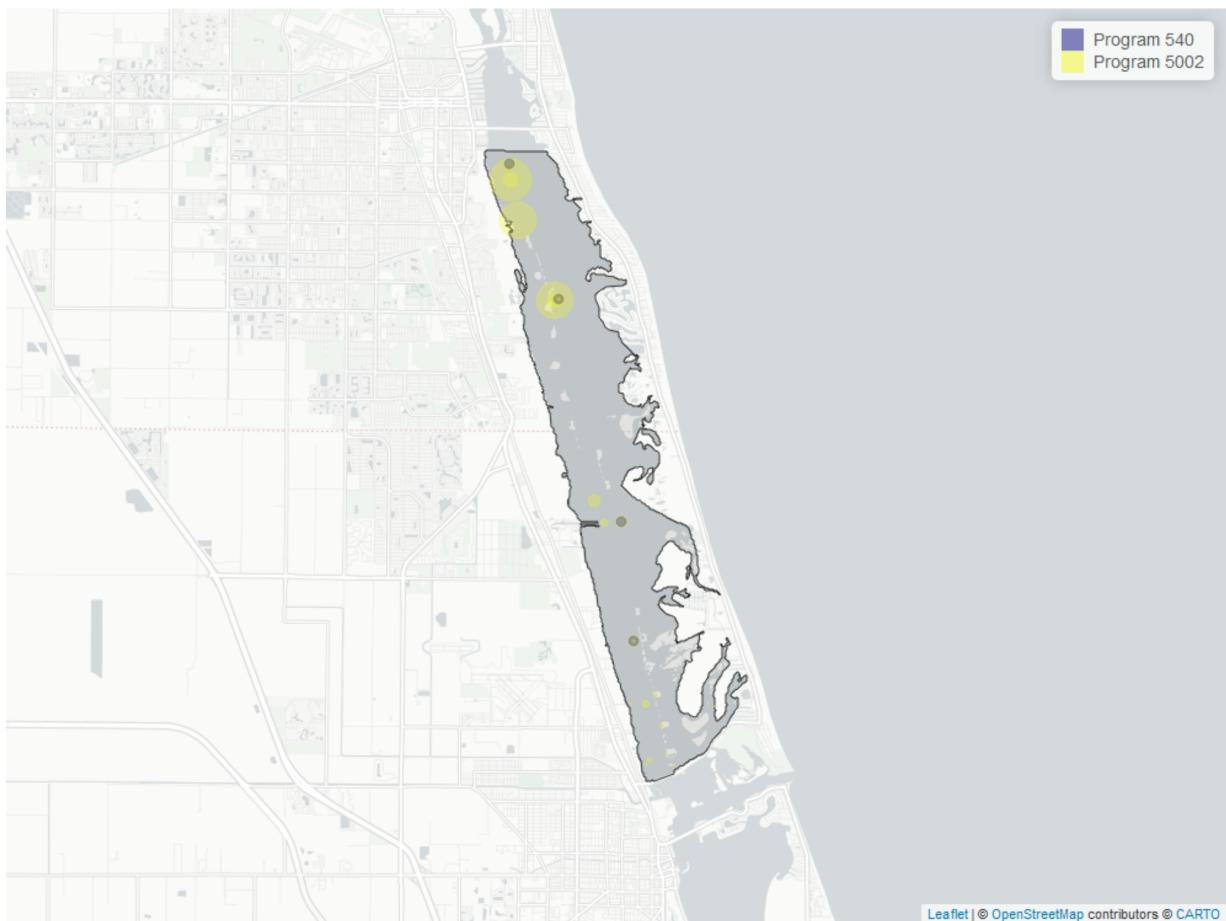


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	1008	27	0.531	TRUE	-0.4134	0.0000	-0.01709286	0.7200851	4.7057	0.9446	-1

*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 16: Programs contributing data for Total Nitrogen

ProgramID	N_Data	YearMin	YearMax
5002	948	1997	2023
540	60	2016	2020

#### Program names:

5002 - Florida STORET / WIN

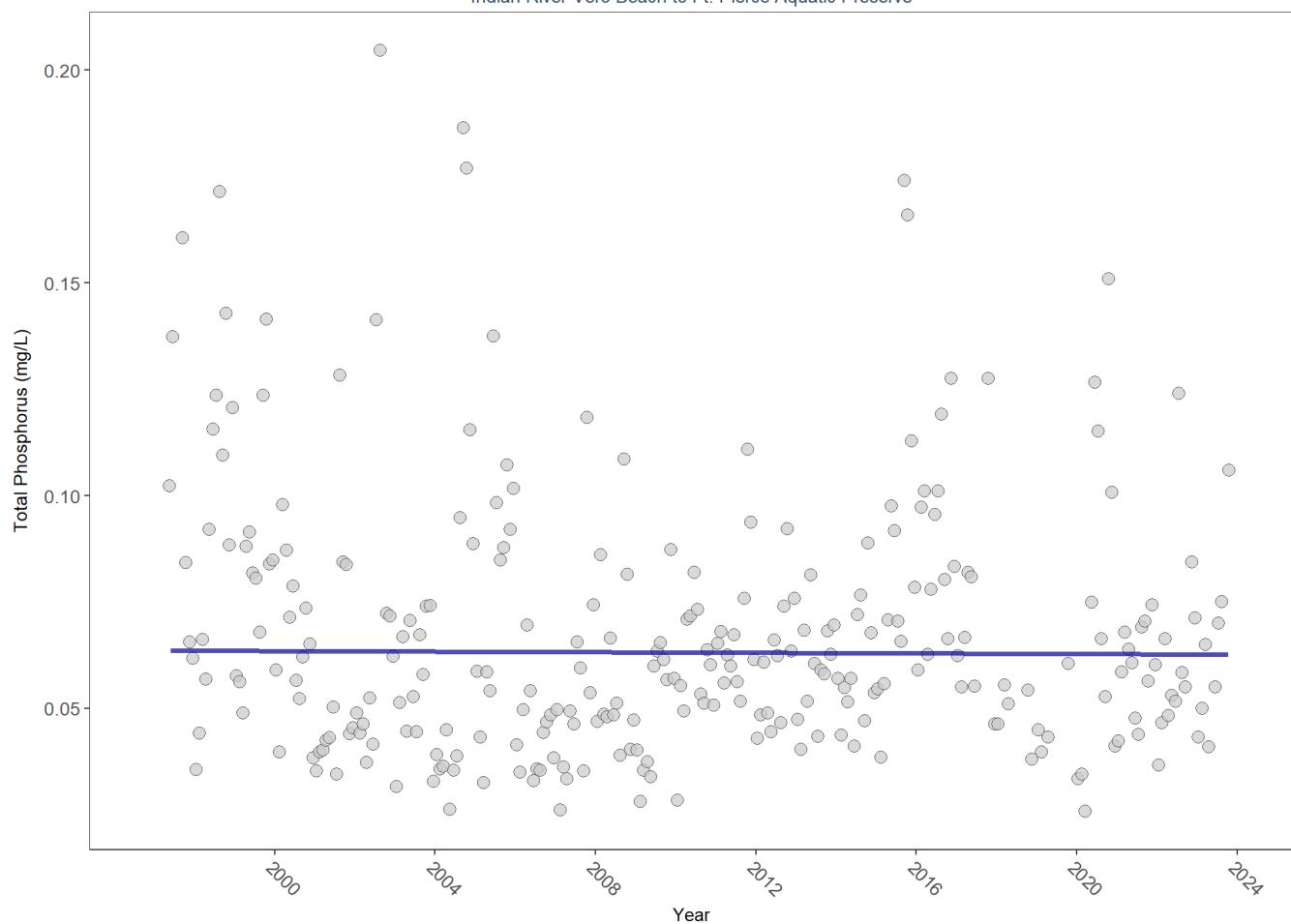
540 - Shellfish Harvest Area Classification Program

There are no qualifying Value Qualifiers for Total Nitrogen in Indian River-Vero Beach to Ft. Pierce Aquatic Preserve

## Total Phosphorus - Discrete Water Quality

### Seasonal Kendall-Tau Trend Analysis

Total Phosphorus, Lab, All Depths  
Indian River-Vero Beach to Ft. Pierce Aquatic Preserve

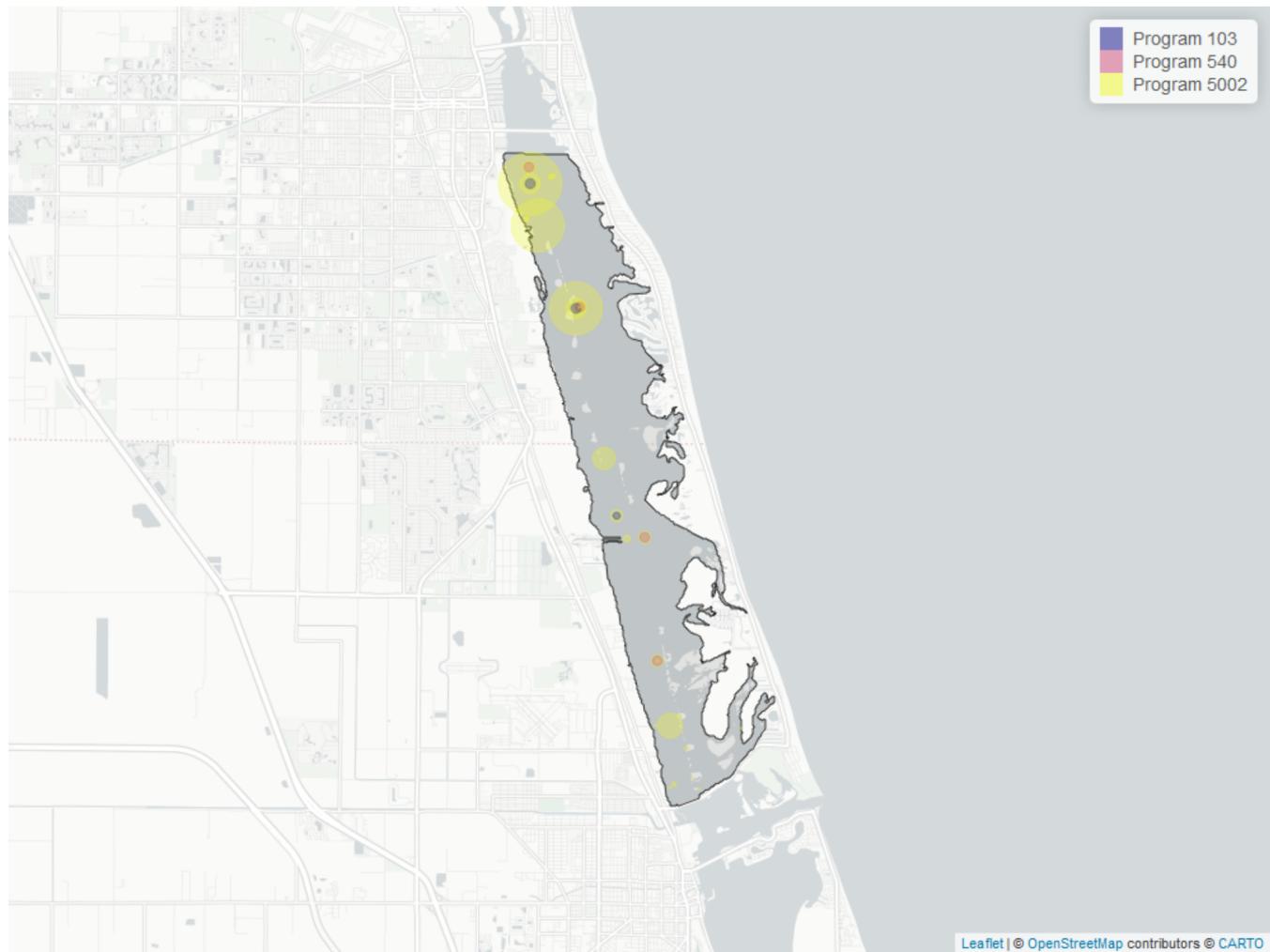


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	2075	27	0.0596	TRUE	-0.0093	0.8612	-0.00003260417	0.06358783	7.8835	0.7237	0

*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



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

Table 17: Programs contributing data for Total Phosphorus

ProgramID	N_Data	YearMin	YearMax
5002	2032	1997	2023
540	60	2016	2020
103	35	2020	2021

#### Program names:

5002 - Florida STORET / WIN

540 - Shellfish Harvest Area Classification Program

103 - EPA STOrage and RETrieval Data Warehouse (STORET)

#### 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 18: Value Qualifiers for Total Phosphorus

Year	$N_{\_Total}$	$N_{\_I}$	$perc_{\_I}$	$N_{\_Q}$	$perc_{\_Q}$	$N_{\_U}$	$perc_{\_U}$
1997	50	5	10.0				
1998	104	14	13.5				
1999	114	3	2.6				
2001	116	2	1.7	8	6.9		
2002	161	28	17.4	8	5.0		
2003	120	29	24.2	12	10.0		
2004	97	26	26.8				
2005	103	13	12.6				
2006	86	25	29.1				
2007	93	32	34.4			1	1.1
2008	76	15	19.7				
2009	86	19	22.1				
2010	86	47	54.6	6	7.0		
2011	80	43	53.8				
2012	68	37	54.4				
2013	75	36	48.0				
2014	75	33	44.0	4	5.3		
2015	74	35	47.3	8	10.8		
2016	68	47	69.1	4	5.9		
2017	44	20	45.5				
2020	50	3	6.0				
2021	86	4	4.7				
2022	49	5	10.2				
2023	15	1	6.7				

**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:

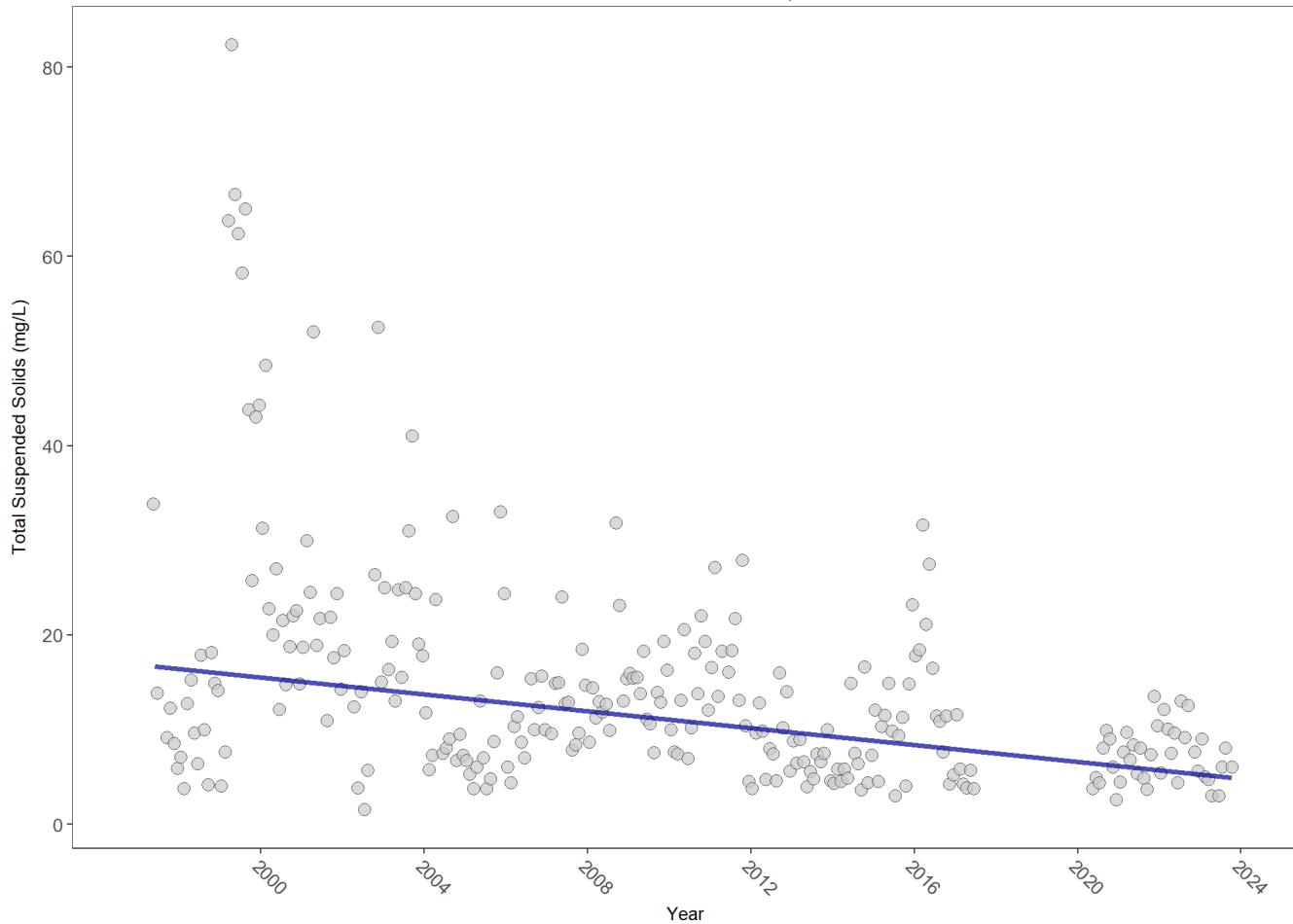
5002 - Florida STORET / WIN

### 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  
Indian River-Vero Beach to Ft. Pierce Aquatic Preserve

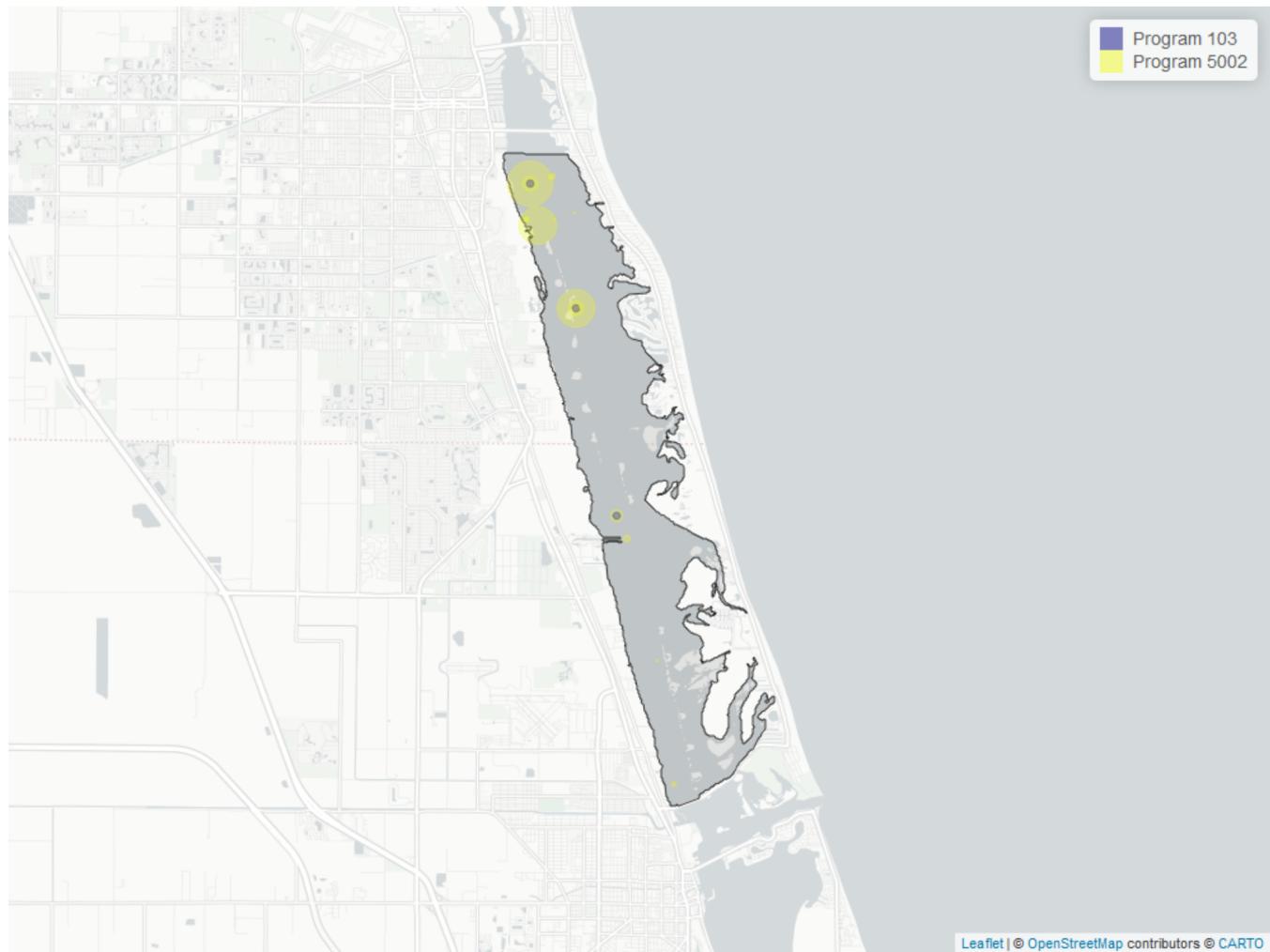


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	875	25	12	TRUE	-0.3148	0.0000	-0.4444444	16.84777	6.0941	0.867	-1

*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 19: Programs contributing data for Total Suspended Solids

ProgramID	N_Data	YearMin	YearMax
5002	882	1997	2023
103	21	2020	2021

#### Program names:

5002 - Florida STORET / WIN

103 - EPA STOrage and RETrieval Data Warehouse (STORET)

#### 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 20: Value Qualifiers for Total Suspended Solids

Year	N_Total	N_I	perc_I	N_Q	perc_Q	N_U	perc_U
1997	34	14	41.2				
1998	50	41	82.0				
1999	58	3	5.2				
2002	58	23	39.7				
2003	59	28	47.5	6	10.2		
2004	42	18	42.9				
2005	44	24	54.5				
2006	36	7	19.4				
2007	47	14	29.8				
2008	32	3	9.4				
2011	33	2	6.1	2	6.1		
2012	24	9	37.5				
2013	28	21	75.0				
2014	24	20	83.3				
2015	24	10	41.7				
2016	24	11	45.8	2	8.3		
2017	12	12	100.0				
2020	16	13	81.2	2	12.5		
2021	50	24	48.0	4	8.0		
2022	27	19	70.4	2	7.4	1	3.7
2023	11	10	90.9			1	9.1

**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:

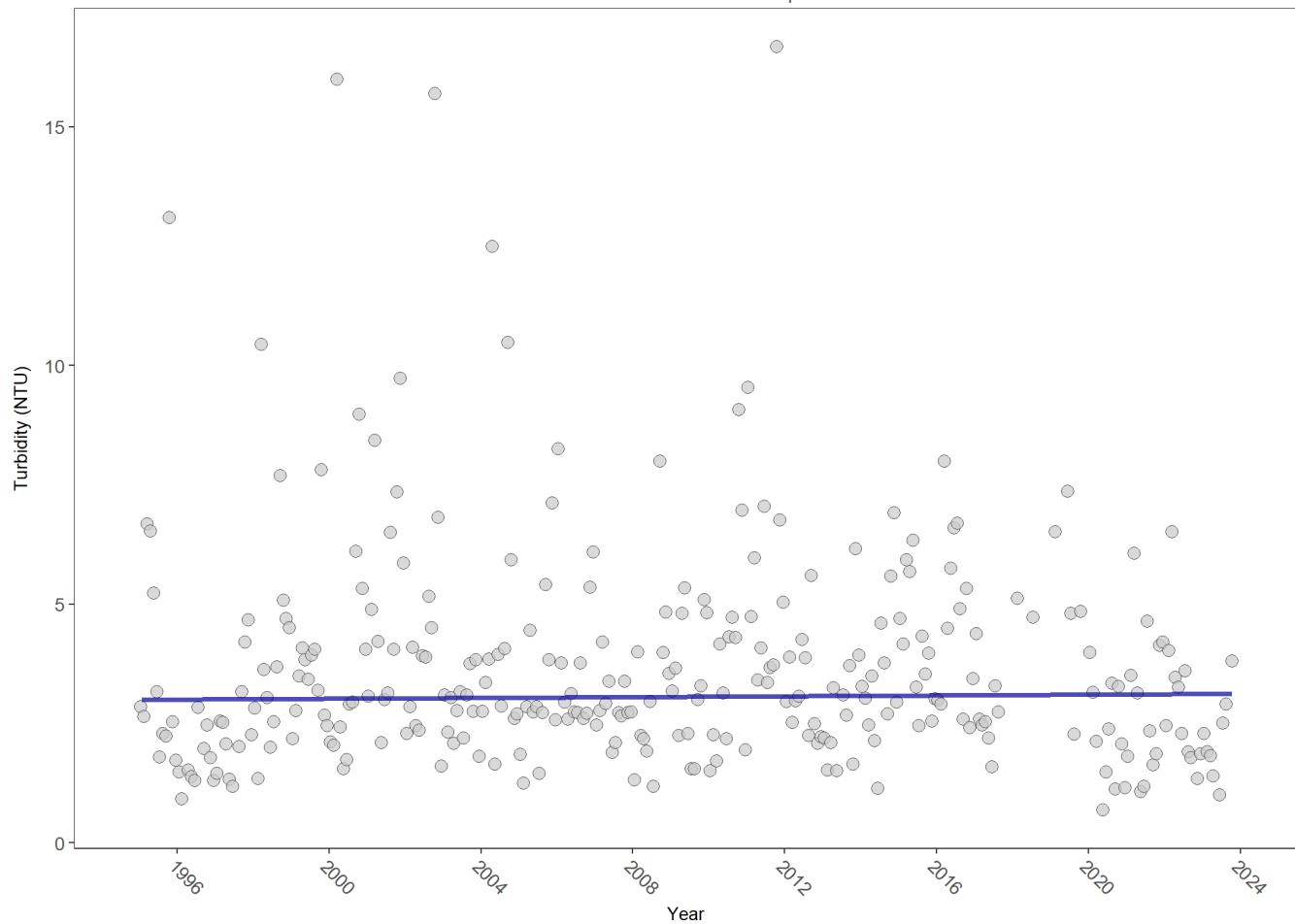
5002 - Florida STORET / WIN

#### 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  
Indian River-Vero Beach to Ft. Pierce Aquatic Preserve

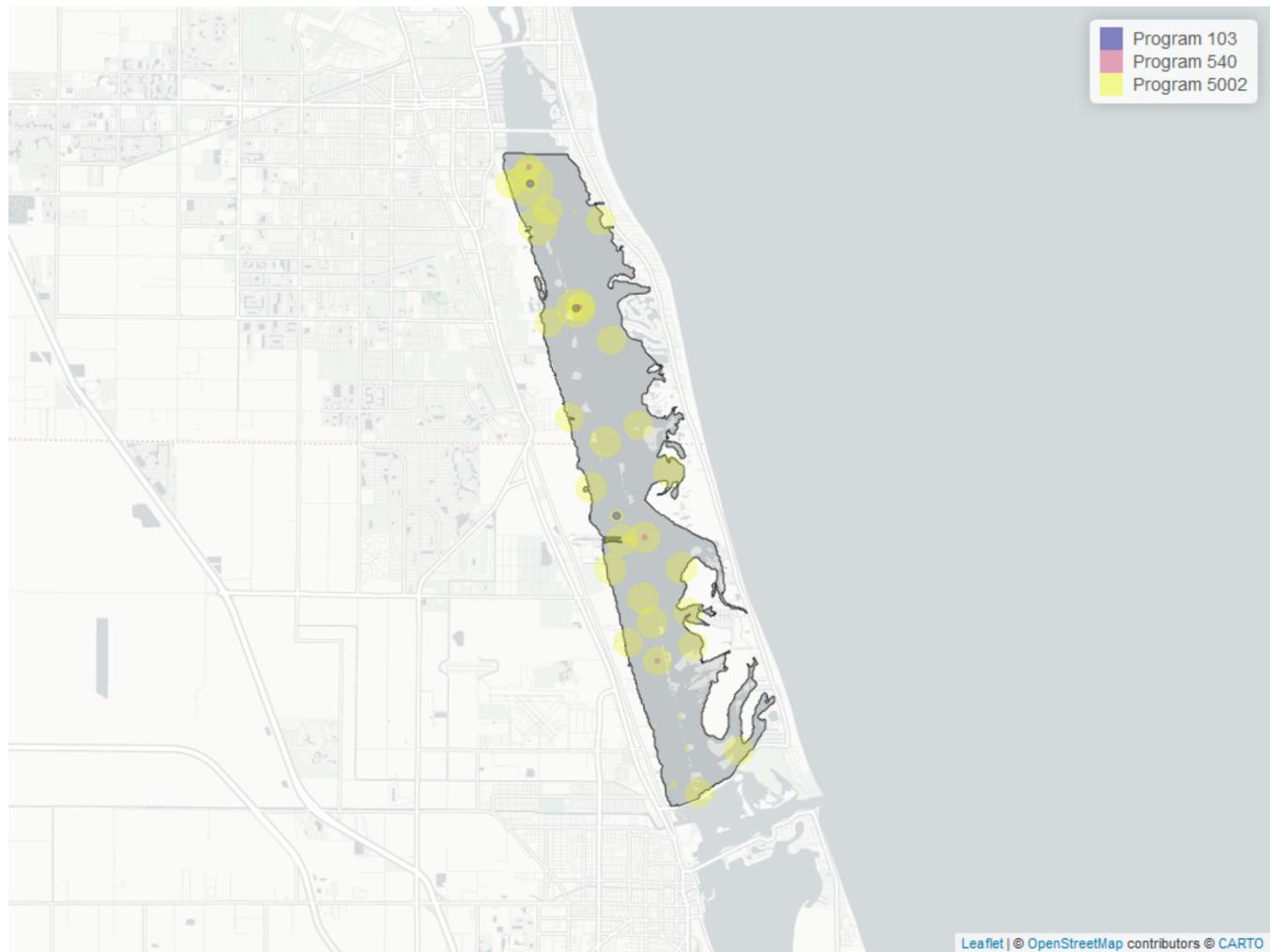


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	4273	29	2.7	TRUE	0.0078	0.7367	0.00433105	3.003456	21.2108	0.0313	0

*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 Turbidity



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

Table 21: Programs contributing data for Turbidity

ProgramID	N_Data	YearMin	YearMax
5002	3954	1995	2023
3013	304	2004	2019
103	21	2020	2021
540	17	2019	2020

#### Program names:

5002 - Florida STORET / WIN

3013 - Seagrass (SJRWMD)

103 - EPA STOrage and RETrieval Data Warehouse (STORET)

540 - Shellfish Harvest Area Classification 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 22: Value Qualifiers for Turbidity

Year	$N_{Total}$	$N_I$	$perc_I$	$N_Q$	$perc_Q$	$N_U$	$perc_U$
1997	229	3	1.3				
1998	315	3	0.9				
1999	298	2	0.7				
2001	251			12		4.8	
2002	196	11	5.6				
2003	297	6	2.0				
2005	239	9	3.8				
2006	185	6	3.2				
2007	223	11	4.9				
2008	167	9	5.4				
2009	172	3	1.7				
2012	87			2		2.3	
2013	44	8	18.2				
2014	41	5	12.2				
2015	46	1	2.2	2		4.3	
2017	26			2		7.7	
2020	33	5	15.2			1	3
2021	50	4	8.0				
2022	27	5	18.5	2		7.4	
2023	11	1	9.1				

**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

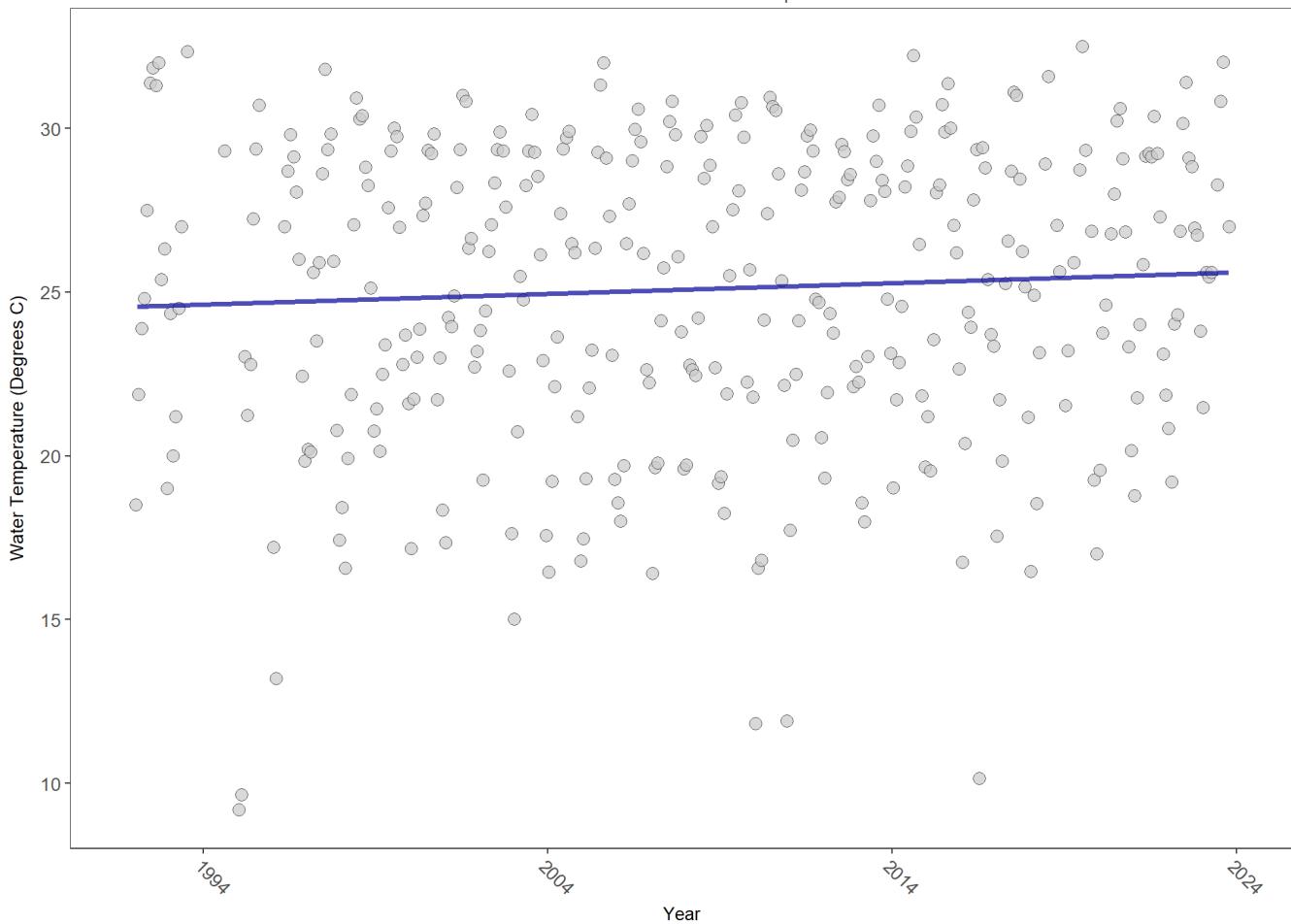
540 - Shellfish Harvest Area Classification Program

### 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  
Indian River-Vero Beach to Ft. Pierce Aquatic Preserve

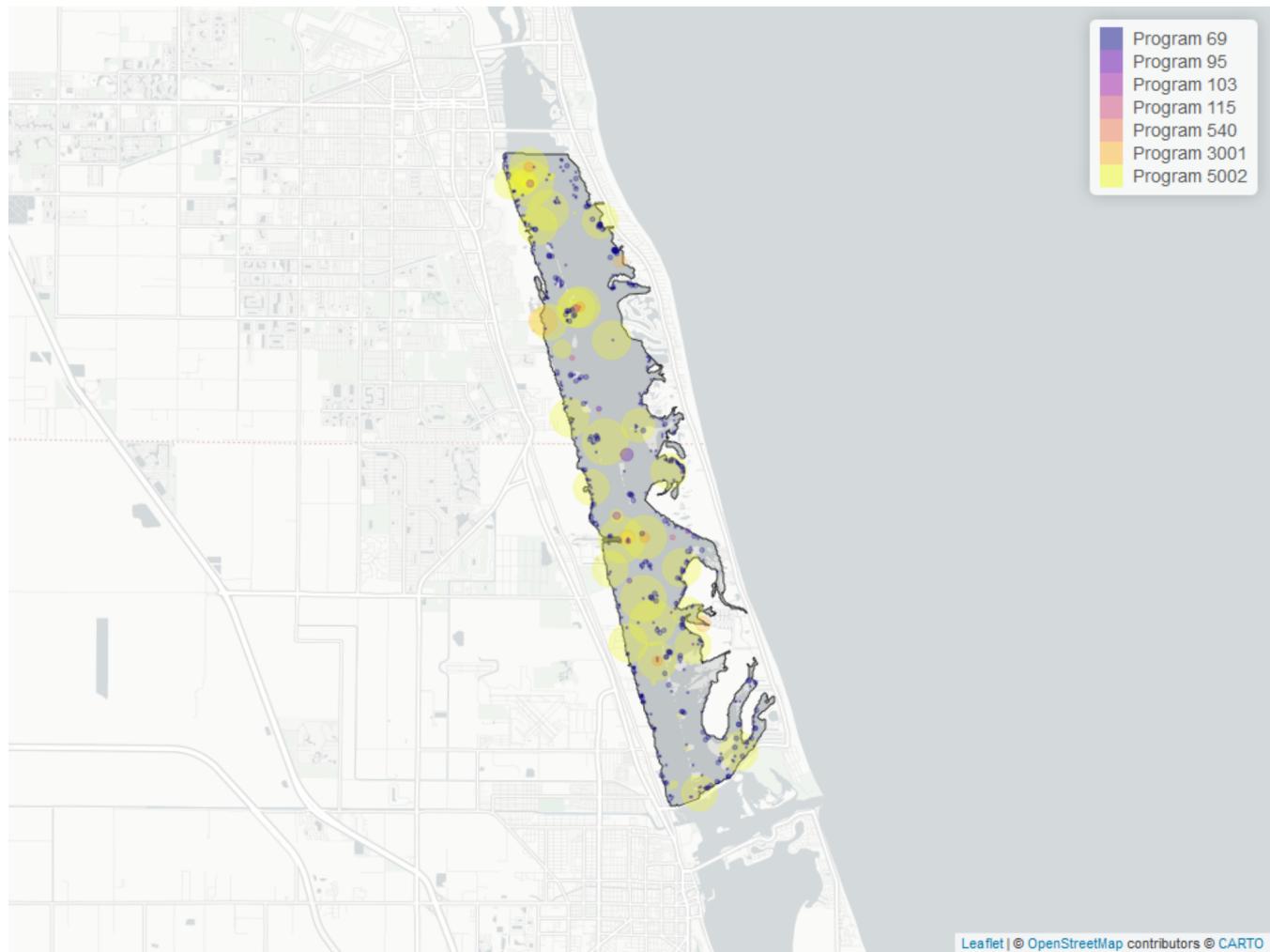


RelativeDepth	N_Data	N_Years	Median	Independent	tau	p	SennSlope	SennIntercept	ChiSquared	pChiSquared	Trend
All	8401	32	25.4	TRUE	0.14	0.0002	0.03294687	24.55978	9.4277	0.5825	1

*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 23: Programs contributing data for Water Temperature

ProgramID	N_Data	YearMin	YearMax
5002	6705	1995	2023
69	1076	1997	2017
3013	376	1999	2023
3001	219	1992	2022
95	64	1996	2018
540	60	2016	2020
103	21	2020	2021
115	7	1994	1995

**Program names:**

5002 - Florida STORET / WIN

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

*3013* - Seagrass (SJRWMD)

*3001* - Lagoon Watch (Formerly Marine Discovery Center)

*95* - Harmful Algal Bloom Marine Observation Network

*540* - Shellfish Harvest Area Classification Program

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

*115* - Environmental Monitoring Assessment Program

There are no qualifying Value Qualifiers for Water Temperature in Indian River-Vero Beach to Ft. Pierce Aquatic Preserve

# Submerged Aquatic Vegetation

The data file used is: All\_SAV\_Parameters-2024-Mar-29.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.

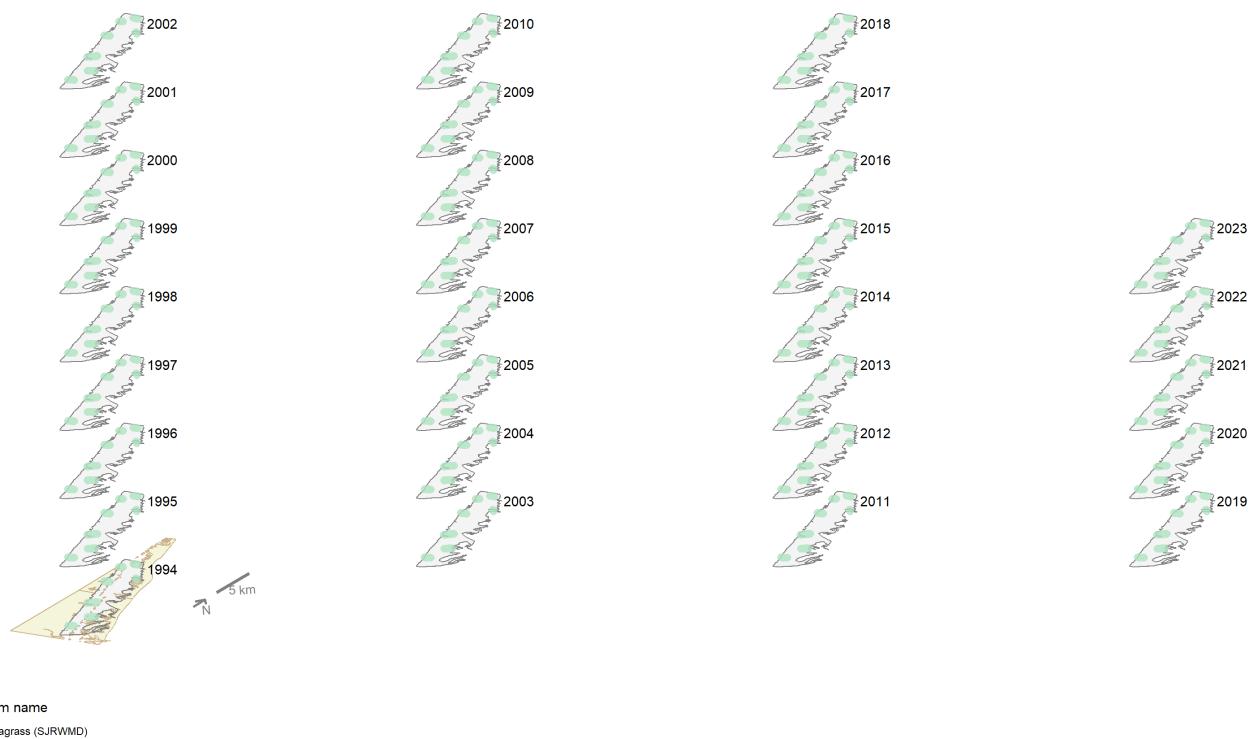
## Notes

*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

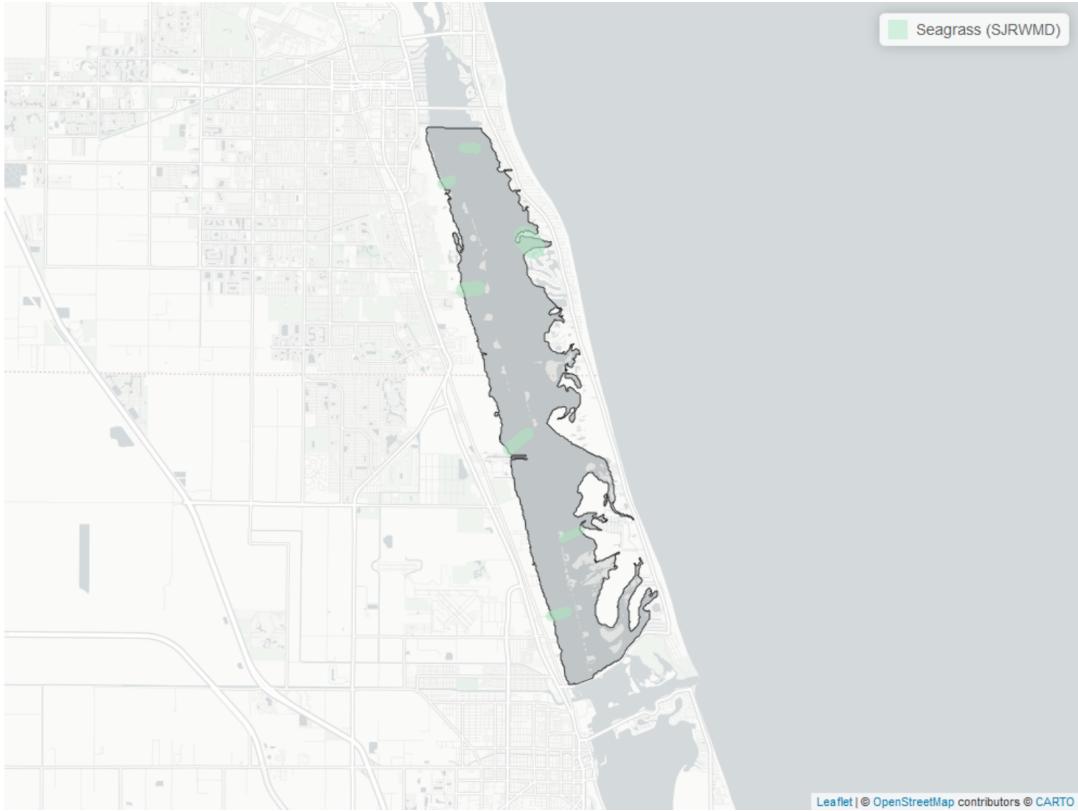
- Biscayne Bay Aquatic Preserve
- Florida Keys National Marine Sanctuary

Indian River-Vero Beach to Ft. Pierce Aquatic Preserve  
SAV Percent Cover - Sample Locations



Maps showing the temporal scope of SAV sampling sites within the boundaries of *Indian River-Vero Beach to Ft. Pierce Aquatic Preserve* by Program name.

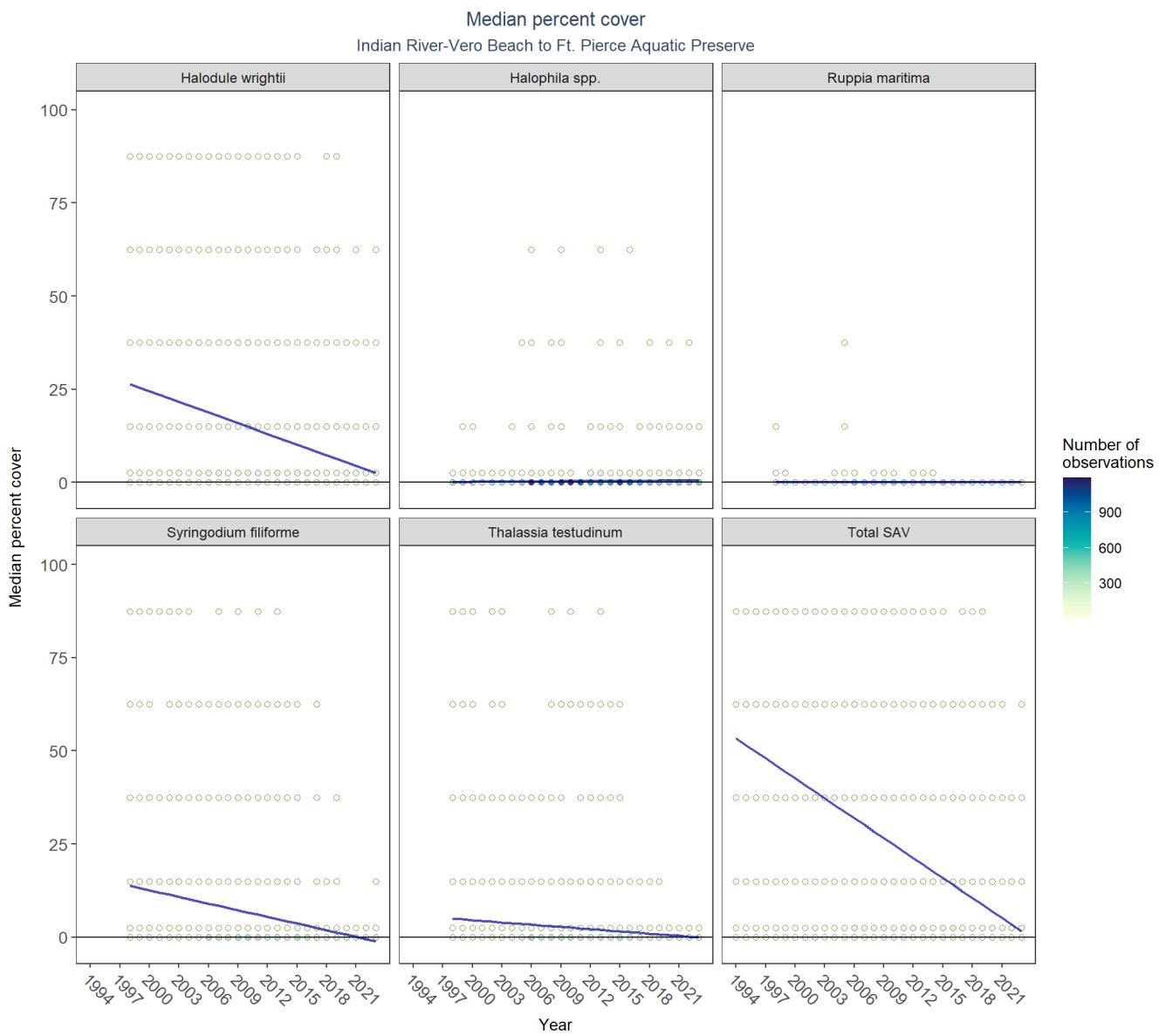
**Sampling locations by Program:**



Map showing SAV sampling sites within the boundaries of *Indian River-Vero Beach to Ft. Pierce Aquatic Preserve*. The point size reflects the number of samples at a given sampling site.

Table 24: Seagrass (SJRWM) - Program 3013

<i>N_Data</i>	<i>YearMin</i>	<i>YearMax</i>	<i>Collection Method</i>	<i>Sample Locations</i>
49427	1994	2023	Percent Cover	7
58571	1994	2023	Percent Occurrence	7



Median percent cover by species in *Indian River-Vero Beach to Ft. Pierce 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.

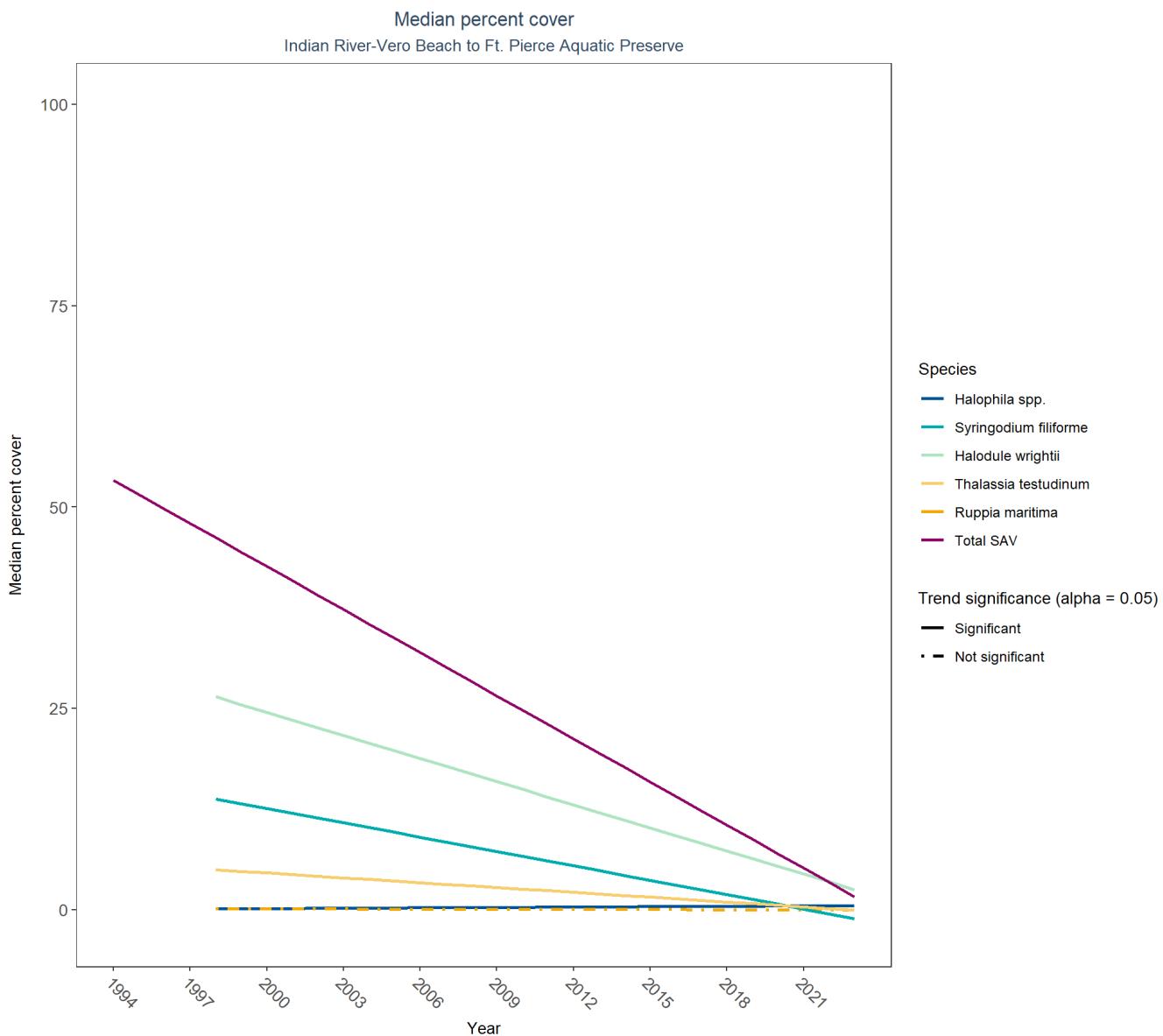
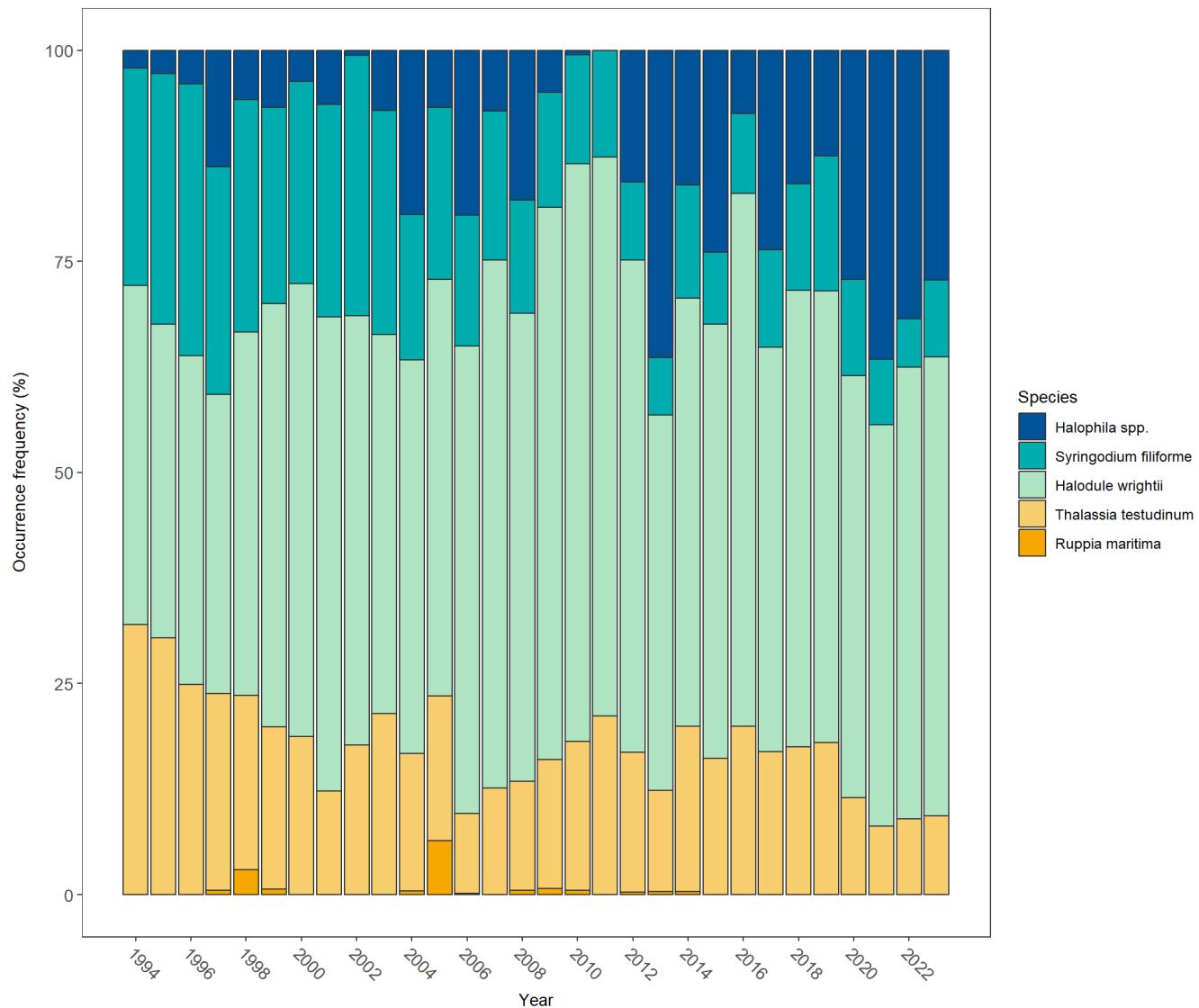
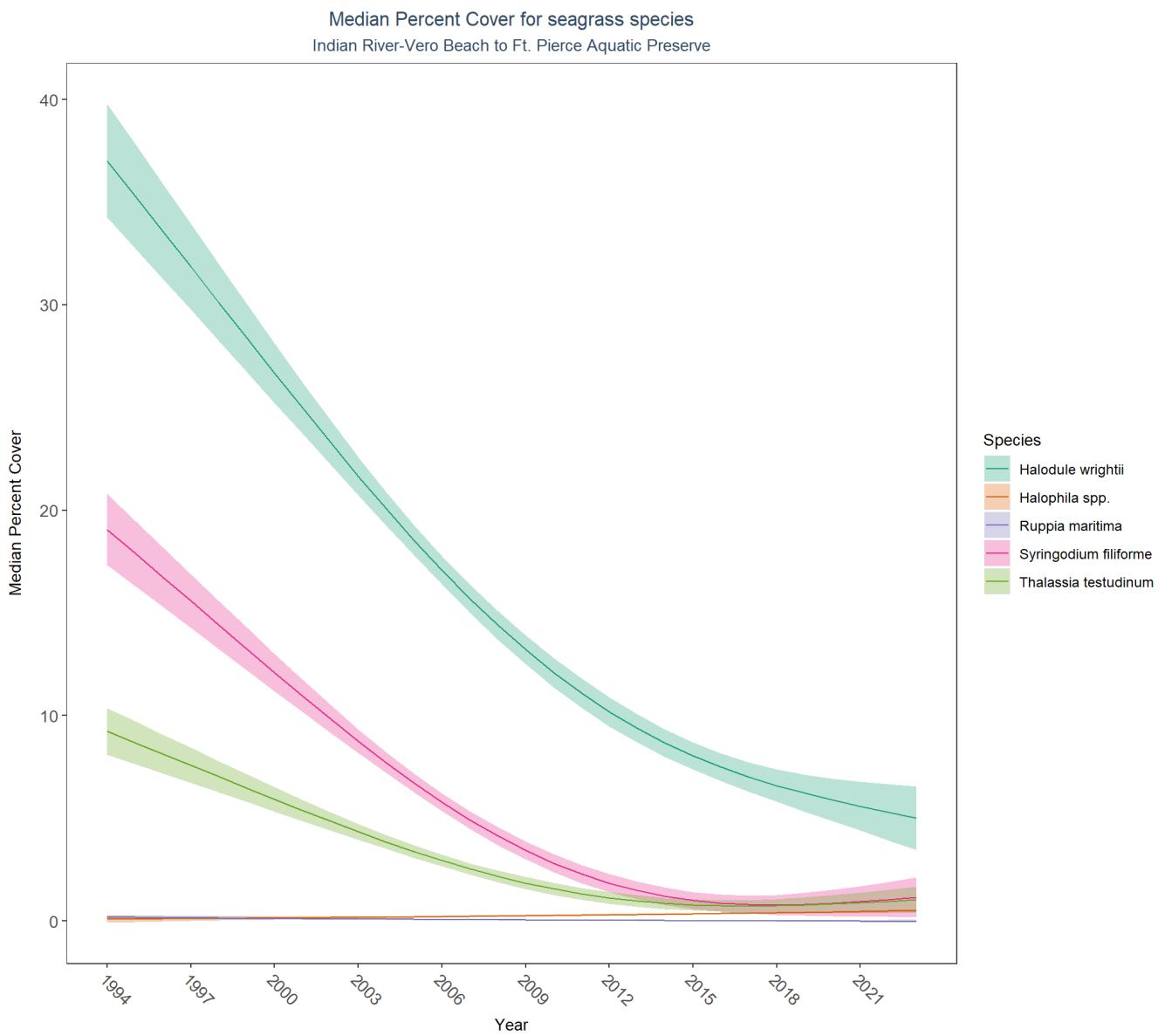


Table 25: Percent Cover Trend Analysis for Indian River-Vero Beach to Ft. Pierce Aquatic Preserve

Species	CommonName	Trend Significance (0.05)	Period of Record	LME-Intercept	LME-Slope	p
Drift algae		Insufficient data to calculate trend				
Halodule wrightii	Shoal grass	Significantly decreasing trend	1998 - 2023	30.2601	-0.9574	0.0005
Halophila spp.		Significantly increasing trend	1998 - 2023	0.0351	0.0166	0.0307
Ruppia maritima	Widgeon grass	No significant trend	1998 - 2023	0.1353	-0.0054	0.1202
Syringodium filiforme	Manatee grass	Significantly decreasing trend	1998 - 2023	16.1460	-0.5949	0.0420
Thalassia testudinum	Turtle grass	Significantly decreasing trend	1998 - 2023	5.7712	-0.2010	0.0151
Total SAV		Significantly decreasing trend	1994 - 2023	53.3244	-1.7836	0.0000
Total seagrass		Insufficient data to calculate trend				

**Frequency of occurrence**  
Indian River-Vero Beach to Ft. Pierce Aquatic Preserve





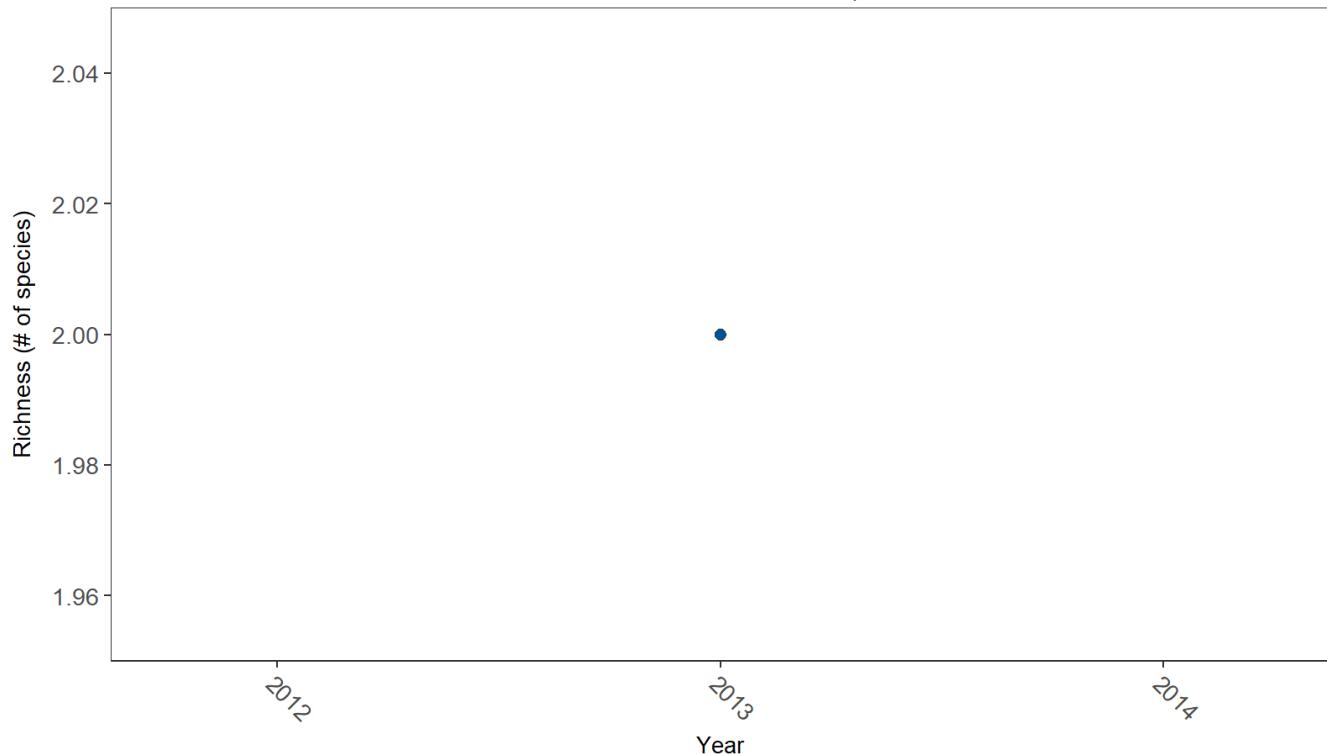
Generalized additive models for each species in Indian River-Vero Beach to Ft. Pierce Aquatic Preserve. Species must have at least 10 years of data to be evaluated.

*Drift algae, Total seagrass, Attached algae, No grass in Quadrat, and Total SAV* are excluded from the analyses.

## Coral Reef

The data file used is: All\_CORAL\_Parameters-2024-Mar-28.txt

Grazers and Reef-Dependent Species Richness  
Indian River-Vero Beach to Ft. Pierce Aquatic Preserve



N_Years	EarliestYear	LatestYear	N_Data	Min	Max	Median	Mean	StDev	Year_MinRichness	Year_MaxRichness
1	2013	2013	5	2	2	2	2	0	2013	2013